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TO ADVERTISERS

CHANGES for advertisements should be in this office by Friday noon for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than Monday noon to ensure publication in that week's issue.

The great strides that have been made in electrical power transmission are nowhere better exemplified than in the fine plant of the Missouri River Power Company, illustrated and described in this issue. In this plant a tension of 50,000 volts is used on the transmission line for regular commercial service. Such electrical pressures as this were unheard of five years ago, and would have been incredible ten years ago. The fact that such pressures can be safely and certainly handled in commercial service speaks much for the perfection of modern apparatus and systems.

THE INSTITUTE'S SUMMER CONVENTION.

The preliminary programme of the nineteenth annual convention of the American Institute of Electrical Engineers has just been made public. The meeting will be held on June 18-21 inclusive, at Great Barrington, Mass., which is famous as being the site of the first alternating-current electric lighting plant to be installed in the United States.

The four days will be devoted, respectively, to the steam turbine, to electric railroading, to the education of electrical engineers, and to the reading and discussion of mathematical and technical papers. The address of the president will be upon the education of an electrical engineer, and already nineteen papers upon subjects of general engineering interest have been listed. A list of these will be found elsewhere in this issue. An elaborate programme of entertainments, including a reception, a dance, a lantern-slide exhibition with five-minute talks by various members, driving, golf and a visit to Pittsfield, has been arranged. The outlook for an interesting and pleasant occasion is perhaps better than ever before. Great Barrington is one of the chain of beautiful towns that are the summer capitals of the Berkshire Hills. It is surrounded by a highly cultivated country, abounding in beautiful views and intersected in every direction with excellent roads. The Institute will enjoy the advantage of freedom from the disturbing influences of great cities and expositions, and will be able to concentrate itself fully upon the programme and the work in hand.

With all the natural charms which this region possesses to supplement the valuable programme that has been provided by an exceptionally efficient committee, it is believed that this meeting will be the most interesting—as it certainly promises to be the most enjoyable—that the Institute has ever had.

AUTOMOBILISM.

The distressing tragedy at the races of the Automobile Club of America last Saturday calls pointed attention to a feature of automobilism as now practised by enthusiastic advocates of that sport in this country. The history of the bicycle is being in some degree paralleled, and a machine containing every element of value, and potential abilities so great that we can now only recognize our inability to see the full possibility of its development, is being seriously damaged in the house of its friends by injudicious exploitation.

The purely sporting side of automobilism makes of these machines racing mechanisms. The question of utility is entirely sacrificed, in the models prepared to compete for speed records, to the maintenance of a tremendous speed for a short distance. Seeing that speed is simply a question of weight and power, it is a little hard to understand where the element of sport comes in when purely mechanical contrivances are raced against one another, unless it may be the inevitable and serious danger that attends their operation. Be this as it may, the practice of fast driving of automobiles, already seriously discouraged by the law, is now responsible for an increasing and perhaps unreasonable public sentiment against automobiles of any sort whatever.

The machine whose brief career last Saturday caused the death of two persons and serious injury to several others was absolutely useless for any purpose whatever, except the establishing of a speed record that, in the nature of things, would last only until a more powerful machine was constructed. It appears that the accident was due to too light mechanical construction of the wheels. From the broader view it makes little difference to what the accident was due. The fact remains that a foolish sport has received a severe discouragement.

The development of the automobile, particularly of the electrical variety, will not proceed along the lines of racing machines. The bicycle seemed to bid fair to become one of the most valuable and useful inventions of its epoch. No sooner, however, was it seized upon as a machine for the establishing of racing records than the general public interest in it as a vehicle of transportation waned, and to-day the bicycle industry is seriously embarrassed by this lack of popular appreciation of the really excellent qualities of the machine. Inevitably the same thing will happen to the automobile if the public come to regard it simply as a dangerous contrivance for sporting purposes. The same money, the same ingenuity and the same engineering skill displayed in constructing an electric automobile to cover a mile in forty-odd seconds would very likely have resulted in building a machine that would transport a truckload of goods at four miles an hour over cobblestone pavements in commercial competition with horses. This is the sort of thing that we want to see. The development of racing machines is unquestionably doing the automobile industry a serious injury.

ELECTRICAL ENGINEER VOLUNTEERS.

At its last meeting the American Institute of Electrical Engineers discussed a subject which is of no small importance—the possible formation of an auxiliary military corps of electrical engineer volunteers. It is to be hoped that the agitation of the subject will not stop with this discussion but will eventuate in the formation of such a volunteer corps, which can not fail to be of high and permanent value.

In Great Britain there has existed for some time a corps known as the Royal Volunteer Electrical Engineers. These volunteers consist for the most part of electrical artisans of various classes, officered by engineers, and were for several years given drills twice a year in the various emergency methods which they would have to encounter in actual warfare. These drills include boat drills, the laying and destruction of submarine cables, the planting of land and submarine mines, the installation of field telegraphs and telephones, the application of searchlights, etc., and even of X-rays. At the outbreak of the war in South Africa the corps went to the front under Major R. E. B. Compton, a well-known electrical engineer, and has recently returned, having covered itself with distinction and proven of great value and importance as a field auxiliary to the regular army.

The situation in South Africa was such as to leave the corps less opportunity to exhibit its professional skill than almost any other war that could be imagined. Notwithstanding this fact, the high value of this technical auxiliary was proven over and over again in the maintenance of communication and other works conducted by them.

So able an officer as General A. W. Greely has given his hearty sanction to the idea of enlisting this volunteer corps. In his remarks before the Institute—which are quoted elsewhere in this issue—he laid peculiar stress upon the fact that in military affairs electricity could play to-day even a more important part than it does in civil affairs. He showed how it was a patriotic duty to make use of every possible advantage which science and engineering could bring to the assistance of the army or the navy in maintaining their efficiency and in making their operations more certain and satisfactory. For this work the electrical engineer and artisan must be called upon. Electrical apparatus can no longer be improvised, and the increasing complexity and extent of the subject make it impossible for the soldier or the sailor to have a proper working knowledge of it. For these reasons the services of a technical corps would be invaluable in the event of a war.

Nor can such a corps be improvised. Under modern conditions wars break out with great swiftness, and the advantage often lies with that side which strikes the first blow and in the shortest time. If we were to become involved in an international dispute, the time between the declaration of war and the commencement of active hostilities would be far too short to organize and drill such a body of men as has been indicated. The organization and drilling ought to begin now, not only as a preparation for war, but also as a school in which the men would be sure to learn much of great advantage to them in all their connections. It is believed that such a service would be very popular, and doubtless the army and navy authorities would do all in their power to encourage its formation and to admit it, possibly, to field manœuvres as a part of its drill and education. It is interesting to note that in the New York State National Guard some movement looking to this variety of organization has already been made. This is at least an indication of the ease with which volunteers could be had, and the popularity of technical service.

With the setting in of the extremely warm season in the belt occupied by the busy centres of population, to all those people who must perforce ride daily or even make occasional trips upon railways parts or all of which run underground, the extreme discomfort which the use of steam as a motive power brings is made distressingly evident.

The principal source of annoyance is in the fact that, in order to keep the foul fumes and steam, to say nothing of the particles which are constantly thrown into circulation, from entering the cars, the doors and windows must be kept tightly closed during the passage of the train through the tunnel. Be the distance traversed ever so small, the distress which this condition occasions is a matter of no inconsiderable moment.

Where the electric traction system has been installed for the purpose of transporting passenger traffic by means of a subway, it has been claimed, and there is no doubt but that there is much merit in the claim, that the subway portion of the trip is by far the most comfortable. From time to time medical practitioners of greater or less eminence have decried against the subterranean transportation of passenger traffic under any condition of motive power, claiming that even under the most favorable conditions of ventilation the source of danger from the vitiation of the atmosphere is alarming in its magnitude. Whatever may be the true scientific status of the element of danger from a physical point of view in subway transportation, the public very generally is now looking to the underground electric railway as the only means for solving the problem of comfortable city-wise transportation.

SOME NOTES ON EUROPEAN PRACTICE IN ELECTRIC TRACTION WITH THREE-PHASE ALTERNATING CURRENTS.

BY CARL L. DE MURALT.

(Concluded from page 718.)

One of the freight locomotives is shown in Figs. 12 and 13. They are designed for a speed of nineteen and one-half kilowatts (about twelve miles) per hour, and will haul a weight of 100 tons (not including their own weight) up the steepest grade of 2.5 per cent. The weight of a locomotive complete is thirty tons, equally divided between two axles. Two motors of 150 horse-power each are mounted on a common shaft half way between these two axles and drive by means of a reduction gear first an intermediary axle and from this axle by means of connecting rods all four driving wheels. These are 1.23 m. (almost exactly four feet) in diameter. A common rheostat serves for starting both motors and there is a controller on each platform as in the case of the passenger cars. The same measuring instruments are also to be found, as well as a Westinghouse and an additional hand brake.

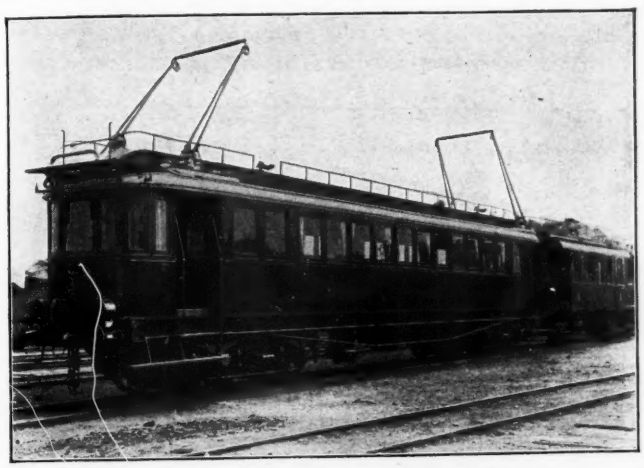


FIG. 14.—PASSENGER CAR WITH TRAILER.

This railway has now been in successful operation for almost three years. It was equipped by Brown, Boveri & Company, of Baden, Switzerland, as well as the other Swiss lines mentioned. Later on some actual results obtained on this road will be given, but attention is directed first to three experimental lines recently installed for the purpose of ascertaining the conditions met on long trunk lines with higher voltages and very high speeds.

Lecco-Colico-Sondrio-Chiavenna Railway—In 1901 Ganz & Company, of Budapest, finished the electric equipment of what is usually called the Valtellina Railway in the northern part of Italy. The length of the line from Lecco to Chiavenna is 65 km. (40 miles), the branch from Colico to Sondrio 41 km. (25 miles). The gauge is normal, equal to 1.43 m. The normal speed is 60 km. (37 miles) per hour for passenger trains, and 30 km. for freight trains. It is evident that under these conditions it would have been somewhat difficult to handle the traffic with 750 or even 1,000 volts, and it was therefore decided to adopt a higher voltage. Tests made in the Altofen shipyard, near Budapest, showed 3,000 volts to be very suitable for the purpose, and this is the line voltage definitely chosen for this road. The power station generates 20,000 volts at 15 cycles per second; 12 transformers, of 300 kilowatts each, along the line about 10 km. from each other reduce this to 3,000 volts. For short periods these transformers can give three times their normal output with a six per cent drop in voltage. There are two 8 mm. trolley wires, the track serving as a third conductor. The rolling stock shows passenger automobiles weighing 50 tons, and freight locomotives weighing 40 tons each. Both are of the double bogie type, with one motor of 150 horse-power on each of the four driving axles. These motors are mounted direct on hollow shafts in the axles, driving the latter by means of a flexible coupling. For the passenger cars the so-called "cascade" connection is made use of, two of the motors being connected to the 3,000 volts directly, the other two to the 300 volts induced in the rotors of the first two. Thus half normal speed is obtained and a certain economy in starting. The freight locomotives, however, use resistances only for starting purposes.

Fig. 14 shows one of the passenger cars with a trailer. The contact device is of the roller type, two copper rollers 40 cm. long being separated by a piece of hard wood 12 cm. long, saturated with paraffin under pressure. In the interior of the cars the high tension is carried in iron pipes insulated inside and connected to earth. The current enters the stators of the motors after passing a high-tension switch placed in a separate chamber. Thus all possible means have been employed to ensure absolute safety to the passengers. Trial runs have been made on this line, but several details seem to need to be perfected, and the line is not yet open for traffic.

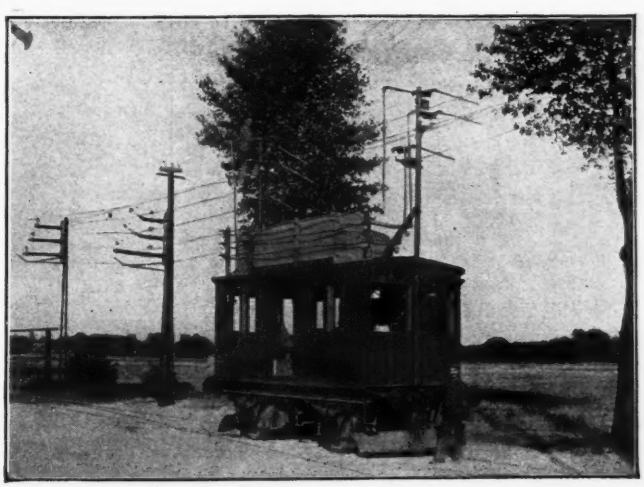


FIG. 15.—SHOWING CONTACT MAKING DEVICE.

Tests at Grosslichterfelde—Still higher voltages were used by Siemens & Halske in 1899 and 1900 during extensive tests made on the Teltower Road between Grosslichterfelde and Zehlendorf on a specially constructed test track a little over one mile long, normal gauge, with curves of 200, 100 and 40 m. radius. On account of the traffic on this public road

the contact line had to be placed on one side of the road, and, for the same reasons, a guard-wire net had to be fixed under all wires. The main object of these tests was to find a suitable contact device and the best possible line construction to handle a current of 10,000 volts and at car speeds up to 60 km. (37 miles).

The first tests were made with a device making contact with the line from above, as shown on Fig. 15. The line wire was fastened to triple petticoat porcelain insulators by means of special brass pieces. The insulators were mounted on wooden cross-arms of different lengths, which were hinged to iron poles in such a way as to permit the tension in the wires to be equalized without difficulty. The three wires formed an inclined plane, as can clearly be seen from the photograph.

Later the line construction was changed and arranged for making contact from the side. The three wires were placed in a vertical plane with distances of about one yard from one another. The wooden cross-arms were replaced by eliptically curved angle irons provided with a guy wire, to which the insulators were fastened inclined toward the track. The line and the corresponding contact devices are clearly shown in Fig. 16.

In both cases tests were made with line voltages of 750, 2,000 and 10,000 volts. The locomotive was fitted with two three-phase induction motors, one on each axle and each for 30 horse-power normal and 120 horse-power maximum output at 650 volts. With 850 volts the output would be increased to 200 horse-power per motor. These motors had interchangeable armatures so that they could be used for 750 or for 2,000 volts directly with the line voltage. For the tests with 10,000 volts on the line, a transformer was installed on the locomotive to transform down to 750 volts. There were two different reduction gears which could be inserted alternately, one for 40 km. an hour, the other for 60 km. an hour. The total weight of the locomotive, completely equipped, was 16 tons.

From the tests made the following results were deduced:

1. It is entirely feasible to use line voltages up to 10,000 volts, and the necessary energy could be taken from the line in each case without difficulty.

2. The contact from the side is rather the better of the two.

The Zossen Railway—These results were availed of for the tests which are now being made on the normal gauge line from Marienfelde to Zossen, about 15 miles long, where the line voltage is 10,000 volts at 45 to 50 periods per second, and the speeds attempted up to 220 km. (135 miles) an hour.

It would be too far to go into details regarding these tests, which have not yet been completed. Suffice it to say that as far as the electric equipment is concerned, they have been entirely satisfactory. The maximum speed obtained up to now is 160 km. (100 miles) per hour.

Fig. 17 shows one of the cars employed, and it will be noticed that line and contact device are shaped after the models used during the tests carried out on the Teltow road. There are four motors per car, each of 250 horse-power normal and 750 horse-power maximum output. The car, when completely equipped, weighs 90 tons and is designed to take 50 passengers.

Tests on the Burgdorf-Thun Railway—Following the programme laid down at the beginning, some special tests made on the Burgdorf-Thun Railway will be described.

First the overload capacity of the passenger cars was tried. These cars were designed to haul normally a total train weight of 50 tons on all grades at a speed of 39 km. (24 miles) an hour.

A test train was put together to weigh 70 tons total—*i. e.*, 40 per cent overload—and the motors did their work very well indeed, starting on the 2.5 per cent grade without any trouble whatever. If, therefore, one of the four motors of a car should ever be temporarily out of order, the other three motors will be able to deal with a normal train alone.

In actual service neither the motors nor the transformers show any appreciable rise in temperature. The transformers are, of course, under load for short periods only, say ten minutes at a time. Their size was therefore evidently not determined by their heating but by the maximum drop in voltage, which, in this case, was not quite ten per cent.

FIG. 16.—SHOWING LINE AND CONTACT MAKING DEVICE.

Fig. 18 shows in curve form the results of some startling tests made under three different conditions.

(*a*) One motor car alone weighing 32 tons.

(*b*) One motor car hauling two trailers, total weight 55 tons.

(*c*) One motor car hauling three trailers, total weight 70 tons.

The curves show speed, amperes per phase and volts as functions of time. The tests were made on the level and the controller manipulated so as to keep the current as nearly as possible constant at 200 amperes. This represents actual working conditions.

Readings were taken on the instru-

ments mounted on the car at regular intervals of five seconds, the usual employé of the road acting as motorman. The automatic speed record made by the speed indicator corresponded very closely in each case with the curves thus obtained.

It will be found that a weight of 32 tons was brought up to a speed of 24 miles an hour in about 32 seconds, a weight of 55 tons in about 57 seconds, and a weight of 70 tons in about 78 seconds.

The total energy input up to the point where full speed was reached is something like 1,600 watt-hours in the first case, 3,000 watt-hours in the second case and 3,900 watt-hours in the third case, or approximately 52, 55 and 56 watt-hours per ton, respectively, a power-factor of 0.8 being used to calculate real energy.

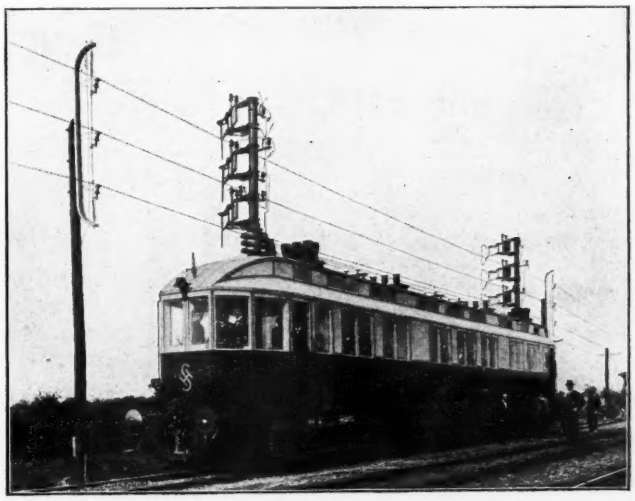


FIG. 17.—BERLIN-ZOSSEN EXPERIMENTAL CAR.

These results appear to compare very favorably with such as have been recently obtained with continuous-current motors, and this in regard to time of getting up speed as well as in regard to energy consumed during acceleration.

By the use of the series parallel controller continuous-current motors can be made to consume, I believe, as a minimum about 40 to 45 watt-hours per ton under similar conditions, which would be a little less than 80 per cent of the energy consumed by the above alternating-current motors. There is, however, this point to be taken into consideration, that the maximum power input in the case of the alternating-current motors is not very much above the average input, while in the case of the continuous-current motor the energy curve has a very decided point, making the maximum input always more than 50 per cent and often 100 per cent more than the average input. The times given above for getting up full speed are rather better than has been obtained so far with continuous-current motors.

Fig. 19 represents some readings taken during a regular time-table run of a normal passenger train weighing 50 tons from Walkringen to Konalfingen, *viz.*, up and down over the highest point of the road.

It will be noticed that very severe grades were encountered. The curves show the normal speed up the grade to be about 38 km., on the level stretch on the top about 39 km. and on the down grade about 40 km. or a slip of about two per cent both ways.

The amperes curve clearly shows the difference between energy consumed in going up, and energy returned when coming down. Of course the power-factor will be different in the two cases, and the real amounts of consumed and returned energy can not be calculated from this curve. It is, however, interesting to see how the voltage increases on the down grade thereby clearly indicating that the load is taken off. This test was made with the brakes wide open all the time and the motor resistances were used for starting purposes only.

A further test showed that by inserting resistance in the motors while on the down grade the speed can be increased materially and the speed reached on this occasion was about 44 km. on a down grade of about 1.4 per cent.

Finally a test was made on a fully loaded train which was going up hill on a 2.5 per cent grade. It was suddenly changed to going down. All brakes were left open and yet the train settled on its downward trip at the normal speed of about 40 km. which was not exceeded. Then its direction was changed again and the start was made without any difficulty whatever.

Conclusions—From these tests we may draw some very interesting conclusions.

I shall first sum up the results more especially in regard to the motors and the car equipment, which may be formulated as follows:

1. If properly designated, alternating-current motors can be made to start under full load with not more than normal full load running current. They will also start under a considerable overload. The only condition which has to be strictly observed in the case of alternating-current motors is that the drop in the line voltage may not exceed a certain percentage, say 15 per cent to be on the safe side. In this respect the continuous-current system is more elastic and a continuous-current motor will start with full torque even under very low voltages. In practice there is, however, no reason for allowing excessive drops in the line. Besides it would be easy to install on particularly exposed points transformers giving a somewhat higher secondary voltage in order to increase the torque of the motors in these cases.

2. In regard to acceleration we may say that alternating-current motors are well adapted for accelerating quickly and uniformly up to full speed. Compared with continuous-current motors they show a somewhat better, *viz.*, shorter time to get up full speed, a somewhat increased amount of energy consumed during the acceleration and a smaller maximum energy input.

3. During the run we find the speed of the alternating-current motor to be practically constant on the level as well as on all grades, as it is dependent practically only on the number of cycles of the generators. This means that alternating-current motors must be proportioned so as to be able to draw the maximum weight at normal speed on the maximum grade. Continuous-current motors need not have the same output, as it is possible, especially in the case of several motors per car, to give the motor momentarily a greater torque by reducing the speed. This, however, is only feasible within certain limits and actual practice has shown that the gain in weight of motor thus obtained is very small compared with the weight of an alternating-current motor running always at the same speed. In most cases it will hardly exceed 10 to 15 per cent. Besides, as pointed out above, the voltage of the line might be increased at the grades in order to increase the capacity of the alternating-current motor.

4. On down grades the alternating-current motor acts as a generator returning energy to the line. This recuperation of energy is not only theoretically feasible, but is of actual interest in the case of prolonged down grades where the efficiency during starting, makes the controlling apparatus more complicated and it is therefore preferable in most cases to adhere to the ordinary resistance control, which has already showed up to be pretty efficient after all.

Concluding, I might now make the following few general remarks regarding the applicability of the two systems for traction purposes:

Both systems are probably capable of satisfactorily doing the work demanded

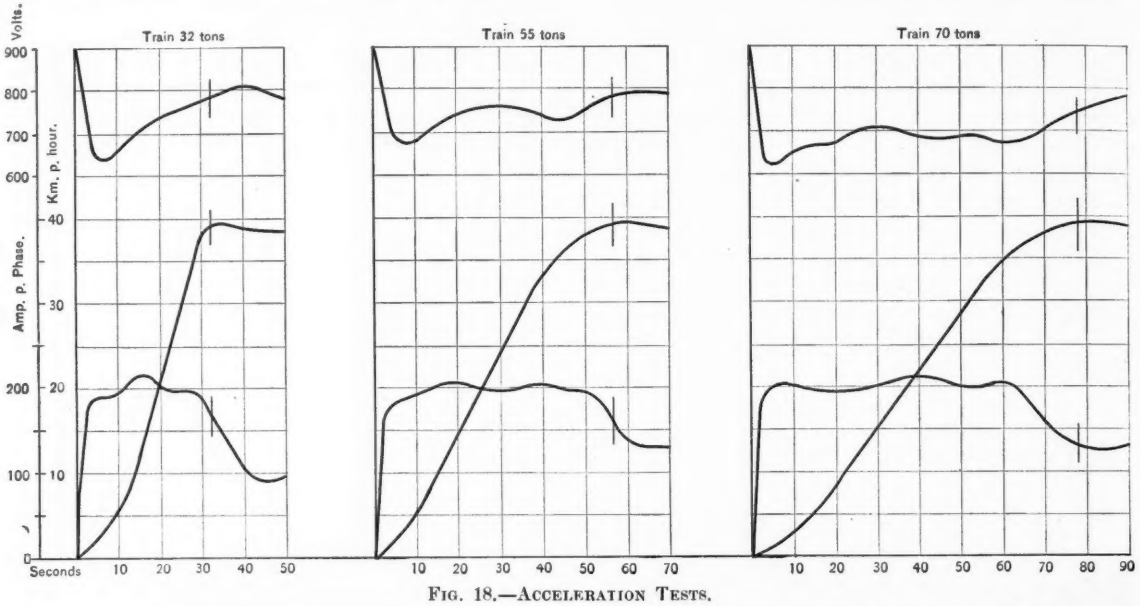


FIG. 18.—ACCELERATION TESTS.

motors thus automatically brake themselves and where the descending trains greatly relieve the power station. In Siemens & Halske's tests, the alternating-current generators were driven by continuous-current motors from a storage battery. When the car was going down grade, energy was returned and the storage battery actually charged. The Swiss mountain lines have installed water resistances to use up the excess of energy made free by descending trains.

5. In a mechanical way the alternating-current motor is, of course, superior to the continuous-current motor. The absence of the commutator alone is an advantage. Then the voltage in the rotor can be chosen as low as convenient, which makes the rheostats better and safer. All the Swiss roads which have been operated now between three and four years—the Lugano Tramways even seven years—report having had practically no repairs whatever on any parts of the electrical equipment, none whatever on the motors, which is more than can be said of the usual continuous-current equipment.

6. Finally, the manipulation of the cars is greatly simplified by the constancy of speed which in this connection is a decided advantage. All the motorman has to do is to start his car and bring it up to speed. The car itself will do the rest until it is stopped by the application of the brake. The concatenated motor control, although showing a slightly better

Now in regard to the line we find:

7. The increased voltage admissible for alternating-current systems reduces the dimensions of the line wires. If carried beyond a certain point the insulation will, however, have to be increased. In cases where the energy used is so large that it can not be taken off the line at voltages below 1,000 volts, alternating current becomes a necessity. I believe that 100 to 150 amperes per contact device is just about the maximum permissible, although I know that in some cases, especially in America, as much as 300 amperes have been taken off by one trolley-wheel.

8. The transformation of the high-voltage alternating currents universally used for transmission on long roads into continuous current means the installation of rotary converter substations. For transformation into alternating currents stationary transformers are used which do not call for any particular attendance and having no rotating parts do not show any deterioration from use.

by any traction problem. I therefore repeat that each case ought to be studied for itself in order to find out which system presents the greater advantages.

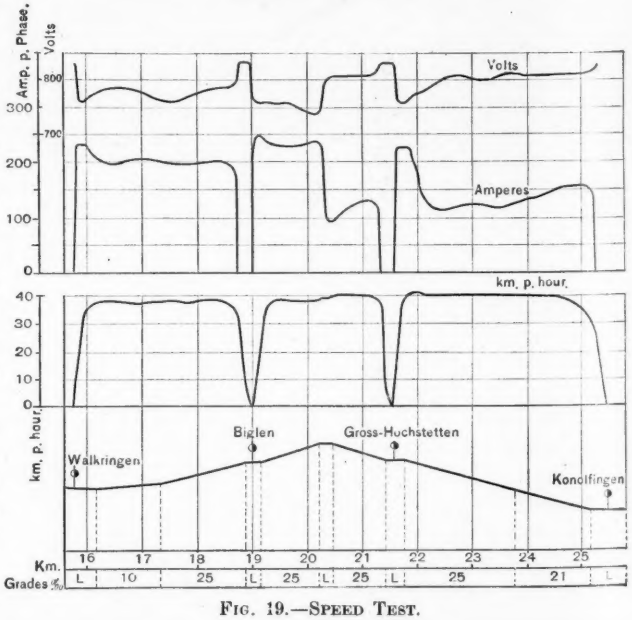


FIG. 19.—SPEED TEST.

Very irregular profile and frequent stops, especially if combined with greatly varying speeds, as found, for instance, in congested city street traffic, make a line generally more suitable for continuous current, while a regular profile, even in the case of steep grades, and long runs between stations would make it better fitted for alternating currents.

The 50,000-Volt Transmission Plant of the Missouri River Power Company.

By W. G. McConnon.

MUCH INTEREST is being manifested in engineering circles in regard to recent remarkable developments in electrical power transmission over long distances and in the attendant use of higher and higher voltages. Although several plants have been proposed for the use of voltages higher than 40,000, the distinction of being the first to place in actual commercial service a large plant employing 50,000 volts transmission belongs to the Missouri River Power Company. This installation was completed and the apparatus placed in operation about the first of March, and much credit is due to the general manager and engineer of the company, Mr. M. H. Gerry, Jr., who planned and executed the general undertakings, as well as to the Westinghouse Electric and Manufacturing Company, which furnished the electrical equipment.

FIG. 1.—A GENERAL VIEW OF THE POWER-HOUSE, DAM AND SURROUNDINGS, SHOWING GENERAL CHARACTER OF THE COUNTRY ABOUT CANYON FERRY, MISSOURI RIVER POWER COMPANY.

It is to be noted that since the starting of the plant there has been no mishap of any kind to the line or apparatus. This, the writer believes, is somewhat exceptional in undertakings of this magnitude and character, since it is generally expected that at the start minor difficulties are liable to be met with which, though possibly not serious, will nevertheless affect the continuous service of the plant.

The present power-house of the Missouri River Power Company is located on the Missouri River, about twenty miles almost directly east of Helena, Mont. To those who are familiar with the early history of the Northwest, it will be recalled that, in the famous Lewis and Clarke expedition of 1803-1804 up the Missouri River and across the continent to the Pacific, one of the resting-places and points of interest spoken of is Black Rock Cañon, met with soon after entering the Rockies at the "mouth of the mountains," which is some miles to the east. Black Rock Cañon is not now known by this name, but at the mouth of the cañon lies the present little town of Cañon Ferry and the power-house of the Missouri River Power Company. A general view of the power-house and town is given in Fig. 1, which shows them located in a country not as rough as some parts of the Rocky Mountain district, but by no means level. The district immediately about Cañon Ferry has been one of the famous gold mining camps of the West, the discovery of gold having been made here in 1863. Placer mining is the more common way in which mining has been carried on and it can be seen to-day to a limited extent within a mile or so of the power-house.

At the mouth of the cañon a dam has been thrown across the river, about 480 feet in length and designed to give a thirty-foot head of water. The location of the dam at Cañon Ferry had enabled the company to take advantage of a low-lying valley just above the entrance of the cañon, in which to hold at all times a large volume of water in reserve. At the upper end of the cañon the water spreads out over this valley, forming a lake about seven miles long by two to three miles wide. The cañon by which the water comes to the power-house is from 400 to 700 feet wide, and less than one-half mile long. The water in it does not freeze over in winter, and although the lake above freezes over, water flows to the power-house as free from ice in winter as in summer. The amount of water in the river at this point is considered sufficient to develop 10,000 horse-power the year around.

The project for a power plant at Cañon Ferry was first started about ten years ago. The men who probably have taken a more continuous and extended interest in the proposition are Mr. Barton Sewall, of New York city, and ex-Governor Hauser, one of the pioneers of Montana and more thoroughly identified, probably, than any other living man with her history and interests. About four years ago the decision to carry out the work at Cañon Ferry took definite shape, and work was started on a plant of 4,000 horse-power. This plant consisted of four 750-kilowatt, 550-volt, two-phase Westinghouse generators, driven by Dayton Globe Iron Works water-wheels, with two ninety-kilowatt exciters driven by independent wheels. The current from these generators was raised by eight oil-cooled transformers from 550 volts to 10,000 volts, and sent to Helena and East Helena, twenty and fourteen miles away, respectively. At Helena the current was used, after transformation to 2,200 volts, for driving induction motors direct-connected to arc light machines supplying city lights, and for distribution for general incandescent lighting. Two rotary converters, furnishing current to the

street car system of the city, were also supplied. At East Helena the current was used mostly for driving induction motors in the large smelter located there and for general lighting about the works. One line from Cañon Ferry also furnished power and lights to a large ore concentrator, between Helena and East Helena, known as the Peck concentrator. The line between Cañon Ferry and Helena consists of but one pole line, carrying, however, four independent circuits—one to East Helena, one to the Peck concentrator and two to Helena, one of the latter for lighting and the other for railway work.

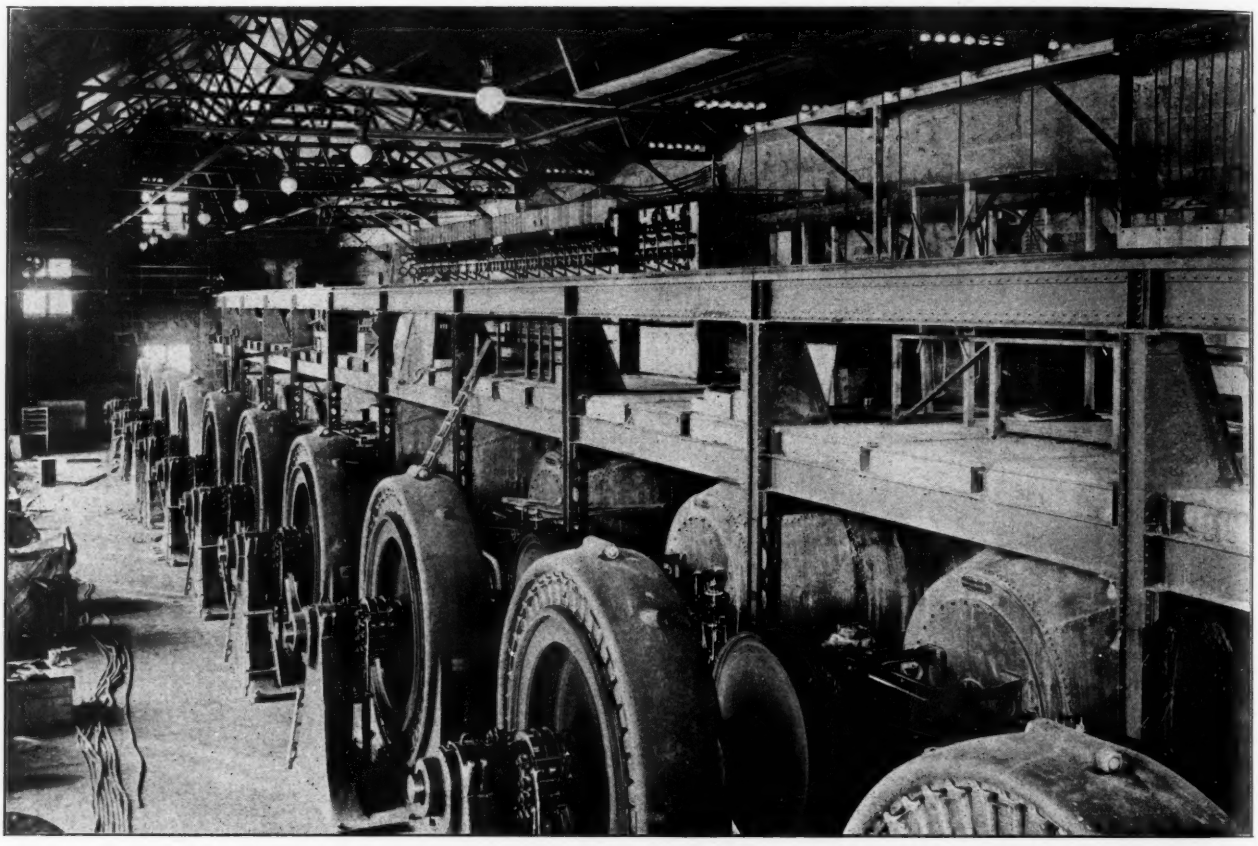


FIG. 2.—GENERAL VIEW OF INSIDE OF POWER-HOUSE, INDICATING RELATIVE POSITIONS OF GENERATORS, WATER-WHEELS AND SWITCHBOARDS, MISSOURI RIVER POWER COMPANY.

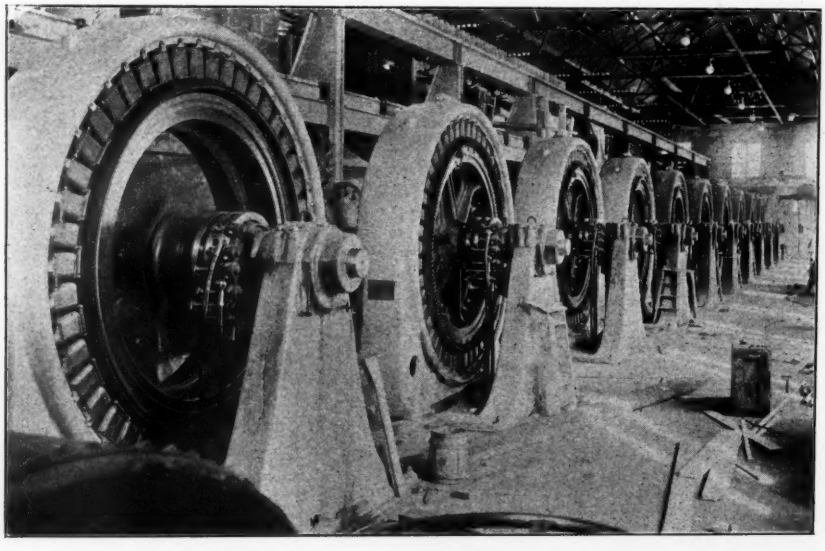


FIG. 3.—VIEW FROM SOUTH END OF POWER-HOUSE, MORE ON A LEVEL WITH GENERATOR FLOOR, MISSOURI RIVER POWER COMPANY.

In the fall of 1900 work was begun at Cañon Ferry with a view of making a very considerable extension of the company's plant, the proposition being to enlarge the plant to a capacity of 10,000 horse-power by putting in additional generators, with exciters, transformers, etc., and to extend the service to Butte, Mont., where it was expected that all the power the company might furnish could be sold. To this end the company has installed six additional 750-kilowatt generators, with the necessary transformers, exciters, etc. These generators are of the same size and voltage as the first four, but are three-phase instead of two-phase. The water-wheels are forty-five-inch horizontal McCormack wheels, furnished by S. Morgan Smith, of York, Pa. All generators in the power-house are direct-connected to the wheels, flexible couplings being used throughout. With the new generators there were also installed a 225-kilowatt, 150-volt exciter driven by a separate wheel, and a 115-kilowatt, 150-volt exciter driven by an induction motor. To sum up, the power plant now consists of ten 750-kilowatt direct-connected generators, with four exciters, of which two are ninety-kilowatt machines direct-connected to separate wheels, one a 225-kilowatt machine with a separate wheel, and one a 115-kilowatt motor-driven generator. To make the plant uniform throughout, the four old generators have been overhauled and changed from two-phase

to three-phase. Fig. 2 shows the row of generators, those in the foreground being new ones and the last four being old machines. The general plan of the station is shown by the outline sketch, Fig. 14, the switchboard gallery being on the right and directly over the water-wheels. Each water-wheel has its own governor; all the new and one of the old wheels having Lombard governors, and the remaining old wheels Replogle governors.

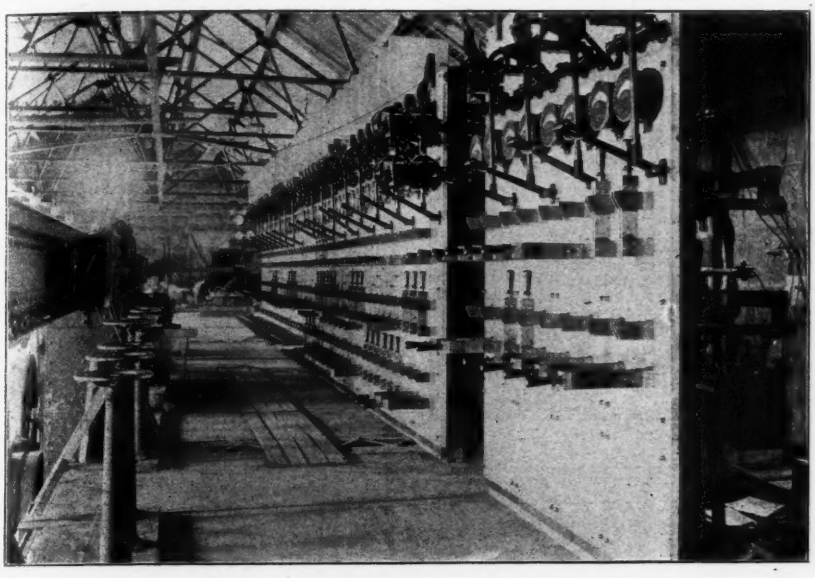


FIG. 4.—MAIN AND EXCITER SWITCHBOARDS.

The switchboard gallery shown on the right of Fig. 2 extends the whole length of the building, and, besides carrying the switchboards, carries also twelve 550 to 10,000-volt, oil-cooled transformers for the Helena and East Helena service, as well as a plug board for connecting these circuits as needed under various conditions. The offices of the company will be located on the floor extending across the building at the end from which the view is taken.

The main switchboard and exciter switchboard shown in Fig. 4 are both relatively simple boards in design, but massive and substantial in construction. The main board is forty-seven feet four inches long and consists of seventeen panels of blue Vermont marble two inches thick. The weight of the board complete is about twenty tons, the copper alone being one-half of this weight. The general arrangement is as follows:

The first five panels at each end are generator panels. The next two panels are feeder panels and are intended for use with the 550 to 10,000-volt transformers. The eighth panel from the end on each side supplies a bank of transformers, 550 to 50,000 volts, for the Butte lines. The middle panel is a junction panel, so that any set of bus-bars on the two ends of the boards can be thrown together, there being three sets of bus-bars on each end of a board. The instruments mounted on the board consist of eight 750-volt alternating-current voltmeters, one for each set of buses and one at each end for the machines, independently of the buses; ten direct-current field ammeters; twenty-eight alternating-current ammeters, with sixteen indicating polyphase wattmeters, and six recording polyphase wattmeters. The recording wattmeters are behind the board. The exciter board consists of four panels of blue Vermont marble, similar to the main board, one for each exciter, with two sets of bus-bars. All field rheostats are mounted under the gallery floor and are controlled by hand-wheels, the shafts of which come up through pedestals in front of the boards. The feature distinguishing the

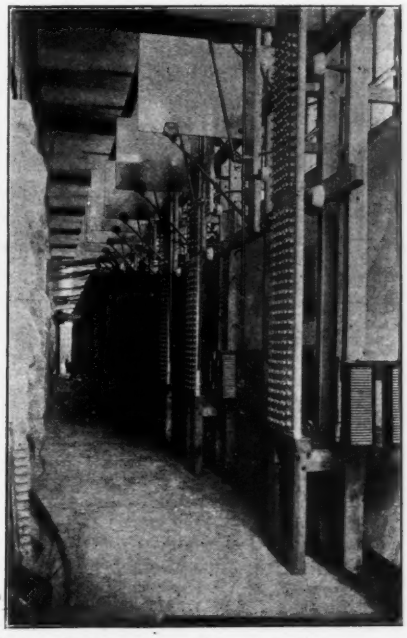


FIG. 5.—TRANSFORMERS, LIGHTNING ARRESTERS, HIGH-TENSION SWITCHES, ETC., MISSOURI RIVER POWER COMPANY.

Missouri River Power Company's plant from all other transmission plants is the high voltage employed on its new lines to Butte. This is 50,000 volts, which is higher than is in use commercially on any other plant at the present time. The distance by pole line from Cañon Ferry to the Butte substation is sixty-five miles, the route corresponding nearly with that taken by the Great Northern Railroad between East Helena and Butte. The line starts out at an altitude of about 4,000

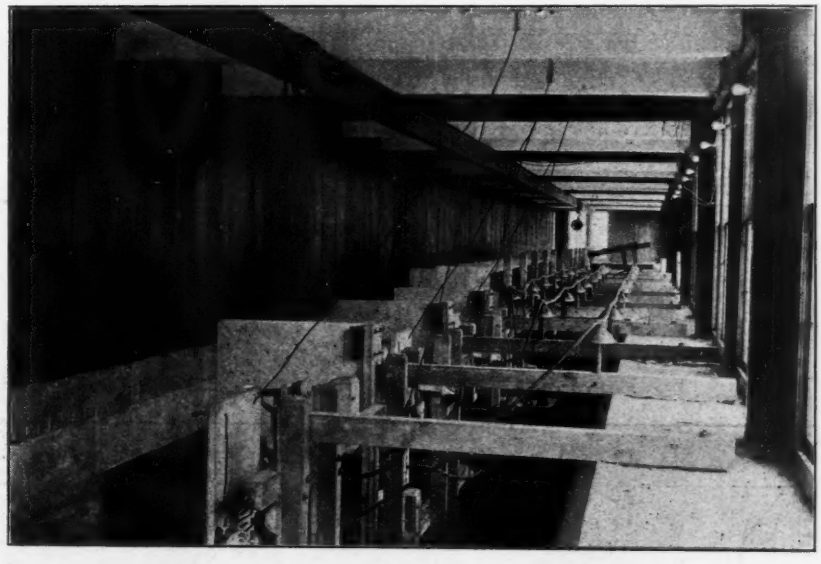


FIG. 6.—HIGH-TENSION BUSES AND METHOD OF ENTERING BUILDING, MISSOURI RIVER POWER COMPANY

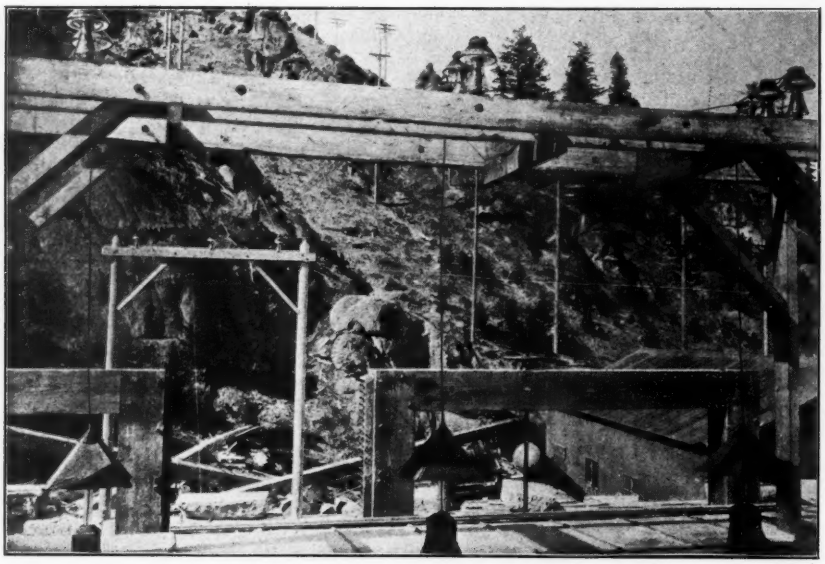


FIG. 7.—METHOD OF LEAVING BUILDING, SHOWING GLASS TUBES AND PROTECTORS, MISSOURI RIVER POWER COMPANY.

feet above sea level at Cañon Ferry and gradually rises until it reaches an altitude of 7,300 feet, where it passes over the Great Divide a few miles east of Butte.

The line itself consists of three lines of poles about fifty feet apart, the cables being arranged in an equilateral triangle, with a spacing of seventy-eight inches between centres, as shown in Fig. 15. Each line consists of three seven-strand copper cables, each cable having a cross-section of slightly over 106,000 c. m. These cables are transposed five times between Cañon Ferry and Butte. The average distance apart of the poles is 110 feet. Fig. 16 shows a view and cross-section of the insulator used on the line, together with the glass sleeve fitting over the pin below the insulator. It has been found, after making exhaustive tests, that a

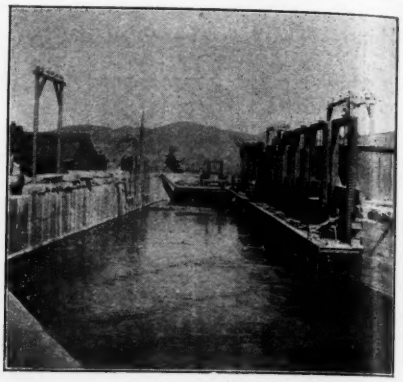


FIG. 8.—THE FOREBAY, MISSOURI RIVER POWER COMPANY.

thoroughly dry oak pin of the length used in this installation, boiled in paraffin, will

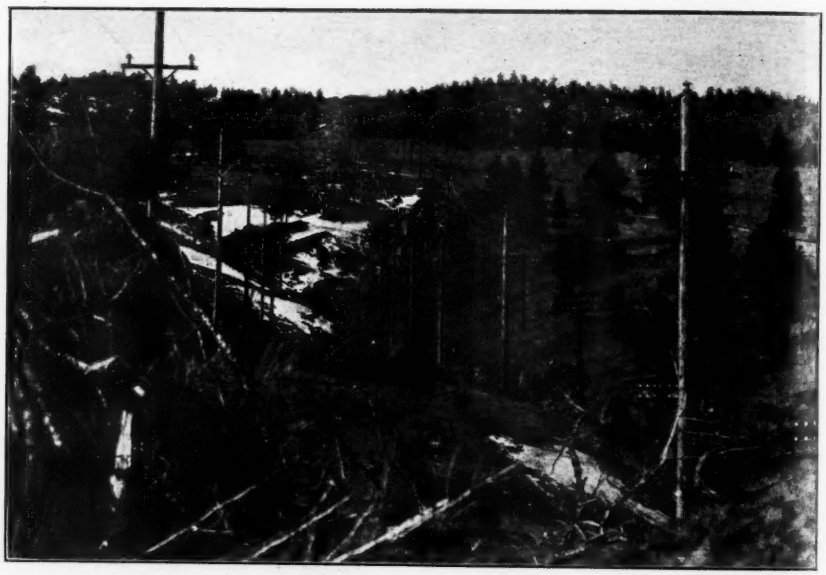


FIG. 9.—THE THREE HIGH-TENSION LINES, TWO LEFT-HAND LINES, 50,000-VOLT WIRES TO BUTTE, MISSOURI RIVER POWER COMPANY.

readily hold up alone under 50,000 volts. Hence the object of the glass sleeve below the insulator is to keep as great a length as possible of the pin dry under all conditions of weather.

The transformers at each end of the line consist of six 950-kilowatt oil-insulated transformers with water-cooling coils in the cases. Those at Cañon Ferry transform from 550 to 50,000 volts, and at Butte the step-down transformer is made from 50,000 to 2,200 volts. The secondary circuits at Butte consist of 600,000 c. m. bare copper cable.

All electrical apparatus in this plant was furnished by the Westinghouse Electric and Manufacturing Company, of Pittsburg.

The customers of the Missouri River

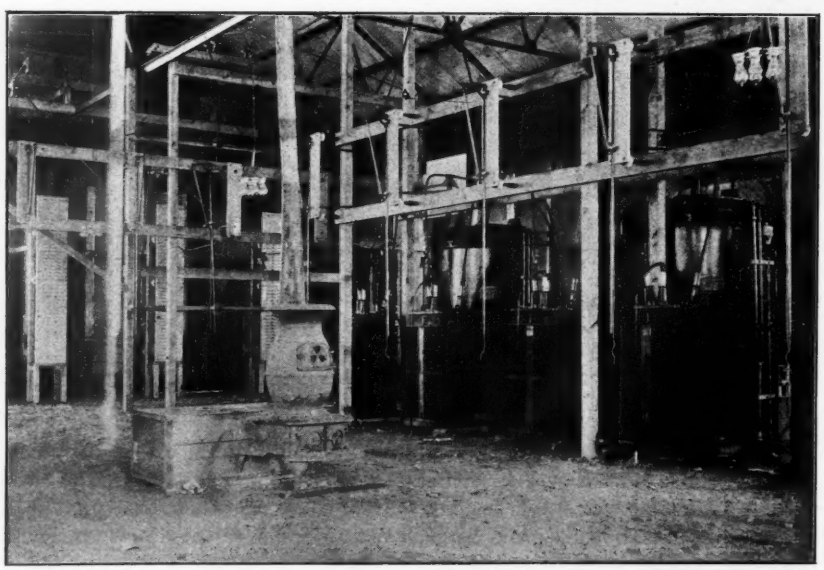


FIG. 10.—INSIDE OF BUTTE SUBSTATION, MISSOURI RIVER POWER COMPANY.

Power Company at present number nine, as follows:

At Helena and East Helena—Helena Power and Light Company, Helena & Livingston Smelting and Reduction Company, American Smelting and Refining Company, Big Indian Mining Company.

At Butte—Anaconda Copper Company, Butte & Boston Copper Company, Colorado Smelting and Mining Company, Boston & Montana Copper Mining Company, Washoe Copper Company.

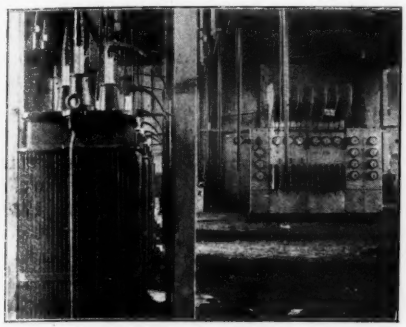


FIG. 11.—TRANSFORMER AND LOW-TENSION SWITCHBOARD IN SUBSTATION, MISSOURI RIVER POWER COMPANY.

The general offices of the company are at Helena, Mont., and New York.

The officers of the Missouri River Power Company are: President, Barton Sewall; vice-president, W. S. Gurner, Jr.; secretary and treasurer, H. Suhr; general manager and chief engineer, M. H. Gerry, Jr.

Canadian Electrical Association.

The twelfth annual convention of the Canadian Electrical Association will be held on June 11, 12, 13 and 14, 1902, in Quebec. The headquarters will be at the Chateau Frontenac. Papers on "The Electrical Equipment of an Ordinary Street Car," Mr. A. B. Lambe, Toronto, Ontario; "Development of Arc Lighting Apparatus, 1810-1902, with Special Reference to Modern Arc Light Engineering," Mr. W. D'A. Ryan, Lynn, Mass.; "Arc Lighting," Mr. C. M. Green, Lynn, Mass.; "Lightning Protection and the Static Interrupter," Mr. Percy H. Thomas, Pittsburg, Pa.; "The Use of Storage Batteries in Electric Distribution," A. A. Dion, Ottawa, Ontario; "Electric Suburban Railways," Edward A. Evans, Quebec, will be presented. Special features include visits to the substation of the Quebec Railway, Light and Power Company, the Quebec-Jacques Cartier Electric Company, a trip around the city of Quebec, an excursion to the Shrine of St. Anne de Beaupre, Montmorency Falls, the annual banquet and a trip on the new wrecking steamer around the island of Orleans, with luncheon served on board. All this will serve to render the convention this year especially attractive. The local committee is composed of Edward Slade, G. U. G. Holmes, Edward A. Evans and Edward Blair.

THE INSTITUTE SUMMER CONVENTION.

PRELIMINARY PROGRAMME.

The nineteenth annual convention of the American Institute of Electrical Engineers will be held at Great Barrington, Mass., on June 18, 19, 20 and 21, 1902.

The headquarters of the Institute will be at the Berkshire Inn, where the convention will be held. Guests will also be assigned to "The Barrington" and the Hotel Miller.

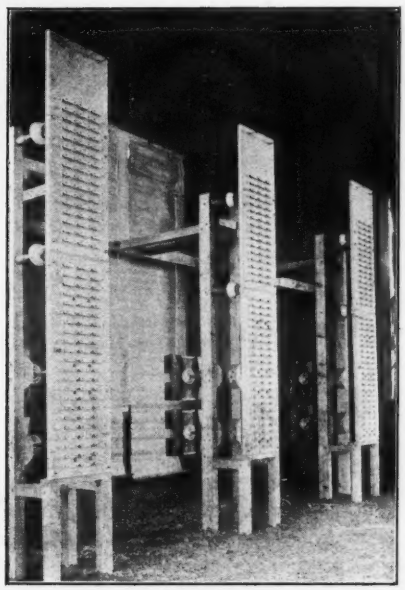


FIG. 12.—LIGHTNING ARRESTERS IN SUBSTATION, MISSOURI RIVER POWER COMPANY.

There will be one morning session of the convention each day. One day will be devoted to the steam turbine, with a paper by Mr. Francis Hodgkinson on the Parsons turbine, and by Mr. R. R. Bowker or a representative on the De Laval turbine. The other sessions will be devoted to electric railroading, the education of electrical engineers and to mathematical and technical papers.

The presidential address will be upon the education of an electrical engineer, and papers will be presented by the following members:

1. "The Function of Series and Shunt Resistances in Lightning Arresters," by Mr. Percy H. Thomas, of Pittsburg, Pa.
2. "A New Photometer for Incandescent Light and Similar Sources," by Professor C. P. Matthews, of La Fayette, Ind.
3. "Method of Compounding Alternating-Current Generators and Motors, Direct-Current Generators, Synchronous-Motor Generators and Synchronous Converters," by Mr. F. G. Baum, of Stanford University, California.
4. "The New Generating Plants of the Niagara Falls Power Company," by Mr. Harold W. Buck, of Niagara Falls, N. Y.
5. "The Use of the Cathode Ray to Produce Stationary Diagrams of Alternating-Current Waves," by Professor Harris J. Ryan, of Cornell University, Ithaca, N. Y.
6. "Formula for Calculating the Electro-Motive Force at Any Given Point on an Alternating-Current Transmission Line," by Mr. Maurice Le Blanc, of Paris, France.
7. "A New Type of Current Tracing Instrument," by Professor R. B. Owens, of Montreal.
8. "The Predetermination of Alternator Characteristics," by Professor L. A. Herdt, of Montreal.
9. "Notes on Railway Speed-Time Curves," by Mr. C. O. Mailloux, of New York.
10. "Method of Ascertaining from Dynamometer Car Records the Power Required to Operate the Mott Haven Division of the New York Central & Hudson River Railroad and the Relative Costs of Operation by Steam and Electricity," by Mr. B. J. Arnold, of Chicago.
11. "Commutation," by Messrs. David B. Rushmore and E. E. Farmer Creighton, of Pittsfield, Mass.
12. "A Study of the Heating of Railway Motors," by Mr. A. H. Armstrong, of Schenectady, N. Y.
13. "The Present Status of Electrical Engineering Education in the United

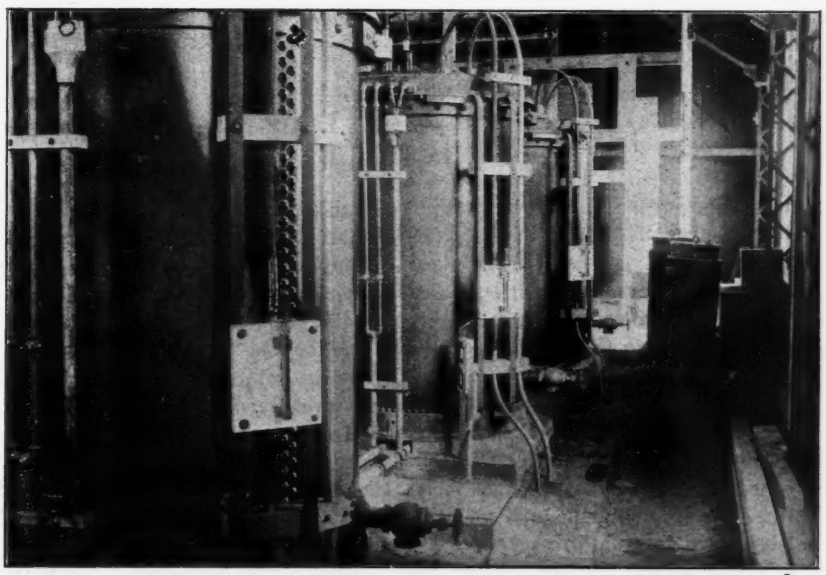


FIG. 13.—REAR VIEW OF TRANSFORMERS, SHOWING LOW-TENSION CONNECTIONS AND WATER-COOLING PIPES, MISSOURI RIVER POWER COMPANY.

States," by Dr. Samuel Sheldon, of Brooklyn, N. Y.

14. "The Electrical Engineering Courses at College," by Mr. E. B. Raymond, of Schenectady, N. Y.

15. "Notes on Experiment with Single-Phase Alternators on Polyphase Circuits," by Mr. C. O. Mailloux, of New York.

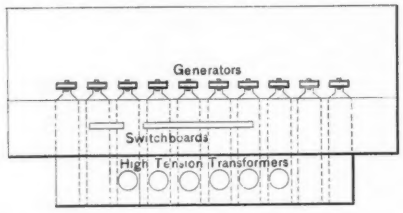


FIG. 14.—PLAN OF POWER-HOUSE, MISSOURI RIVER POWER COMPANY.

16. "Comparative Acceleration Tests of Steam and Electric Traction," by Messrs. B. J. Arnold, of Chicago, and W. B. Potter, of Schenectady.

17. "The Equipment of an Electrical Engineering Laboratory," by Professor R. B. Owens, of Montreal.

18. "Energy Loss in Commercial Insulating Materials when Subjected to High-Potential Stress," by Mr. C. E. Skinner, of Pittsburg.

19. "The Electrostatic Wattmeter in Commercial Measurements," by Mr. Miles Walker, of Pittsburg.

The local committee at Great Barrington, under the chairmanship of Mr. William Stanley, is making every effort to provide for the comfort and entertainment of the members and their guests, especially the ladies.

There will be a reception at the Berkshire Inn on the evening of Tuesday, June 17, followed by an informal dance. Wednesday afternoon tea will be served at "Brookside," the future home of Mr. Stanley, under the management of the Ladies' Thursday Morning Club. Wednesday evening a lantern-slide exhibit with five-minute talks by various members will be given at the Town Hall. Thursday morning Dr. Arthur E. Kennelly will lecture before the Thursday Morning Club in Kellogg Hall, and in the afternoon driving and golf will be indulged in, and light refreshments will be served in the club house at the golf links. There will also be visits to Kellogg Terrace, the beautiful mansion of the late Mrs. Searles, both morning and afternoon.

Thursday evening there will be an assembly with dancing at the Town Hall. This will be one of the principal social features of the programme and no pains will be spared to make it a success.

Friday afternoon, by courtesy of the Stanley Electric Manufacturing Company, a special train will take the party to Pittsfield, where the works of that company will be visited and a lawn tea served at the home of Dr. F. A. C. Perrine. In the evening the Institute will be entertained at the Maplewood as the guests of Mayor England and the board of aldermen of the city of Pittsfield.

The official programme of the Institute will terminate with the morning session on Saturday, June 21.

Throughout the convention carriages will be at the disposal of those desiring to drive during the day, or to and from the evening entertainments. Conveyances will also run at regular intervals to the golf links.

The roads of Southern Berkshire are fine and adapted to driving, automobiling or bicycling. Members or guests desiring to play golf should bring their outfits.

Manager Bruce, of the new Hotel Aspinwall, at Lenox, has extended to the

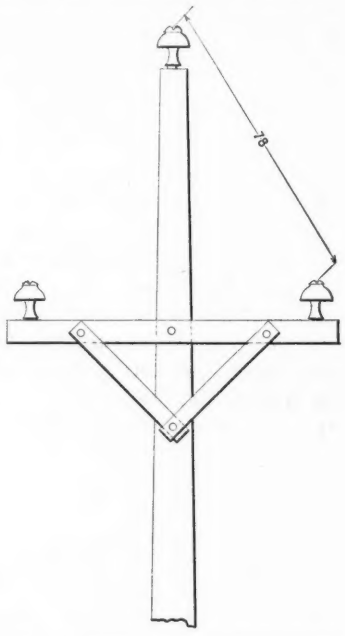


FIG. 15.—ARRANGEMENT OF CONDUCTORS ON TRANSMISSION LINES, MISSOURI RIVER POWER COMPANY.

Institute the courtesies of his house for dinner Saturday afternoon, with transportation to and from Lenox station to all who desire to visit this charming resort in the Berkshire Hills. Those who can spare the time will not only enjoy a beautiful trip but may desire to extend their stay over Sunday.

The committee on papers desires to assure the membership that the convention, together with the opportunity offered to visit this charming section of New England, will be a most delightful occasion.

Rooms will be reserved for those attending the convention from the afternoon of Tuesday, June 17. There will be fifty-eight rooms at the Berkshire Inn and forty-eight rooms at the Barrington. These rooms will be assigned strictly in order of application, except that precedence will be given to past presidents of the Institute who may desire to attend. On account of the limited number of rooms with private bath it is believed that all these will be occupied by members attending the convention who are accompanied by their wives. These rooms will also be assigned in order of application.

The rate of both hotels will be $3 for each person, American plan, for rooms without bath, or $3.50 per day for each person in a room with private bath.

Arrangements have been completed for a special train leaving the Grand Central Station, New York city, at two o'clock on the afternoon of Tuesday, June 17, arriving at Great Barrington about 5.30 P. M. Besides this train there are also through trains at 9 A. M. and 3.30 P. M. on the New York, New Haven & Hartford Railroad (Berkshire division).

Pacific Coast Transmission Association.

At San Francisco, Cal., on June 17 and 18, the Pacific Coast Electric Transmission Association will hold its convention.

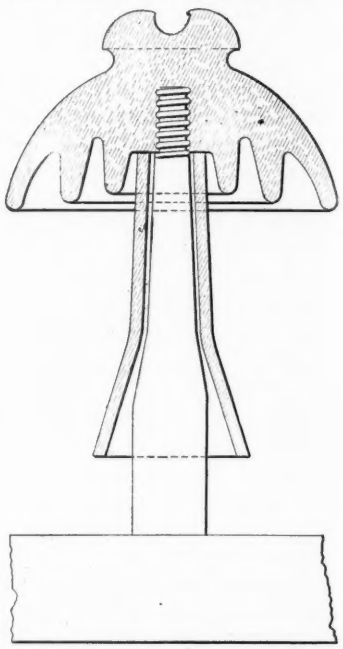


FIG. 16.—HIGH-TENSION INSULATOR, WITH GLASS SLEEVE OVER PIN, MISSOURI RIVER POWER COMPANY.

Mr. George P. Low, of San Francisco, the secretary, states that already a number of important papers have been secured for presentation at this meeting.

Mercury is almost invariably sold pure. If the quicksilver is suspected of being adulterated with lead, tin or bismuth—which is extremely unlikely—such mixture can be shown by rubbing some of the metal on the open palm. If it soils the skin, it is adulterated; if pure, it leaves no trace. If dosed with lead, the drops, instead of being gobular, will be elongated and flattened.

Electricity in the Army and Navy.

A Symposium before the American Institute of Electrical Engineers.

ON THE evening of May 28 the American Institute of Electrical Engineers held a special meeting in the house of the American Society of Civil Engineers, in New York, at which the general subject of the application of electricity in the army and navy was discussed by a number of officers of these services, as well as by some civilian members.

President Steinmetz, in his introductory remarks, welcomed the guests of the evening—the officers of the army and navy—and the members of various sister societies who were present.

The first paper read was that by Mr. Caryl D. Haskins, of Boston, entitled "Civilian Cooperation in the Development of Electrical Devices for Military Purposes." Mr. Haskins's paper was an amplification of the text indicated in his title. He recited the conditions under which civilian cooperation would be highly advantageous, both to the navy and the army and to the country at large. He also thought that the discussion of this cooperation, looking possibly to a recommendation for the establishment of a permanent reserve force, possibly taking the form of a national militia comparable with the Royal Volunteer Electrical Engineers of Great Britain, would be highly beneficial. He also suggested the formation of a committee of the Institute to cooperate with the various bureaus of the army and navy in connection with the development of electrical military projects. Mr. Haskins not being present the paper was read in full by Secretary Pope.

Captain John Stephen Sewall, U. S. A., read a short paper on "Electricity in Its Application to Submarine Mines." This paper recited some of the numerous difficulties that had been found in the installation of torpedoes for harbor defence, and gave numerous vivid incidents of the late Spanish war. Captain Sewall spoke in high appreciation of the work of the corps organized by Mr. C. D. Haskins in Boston as a volunteer assistance to the army during the hurried fortification of that port in 1890.

The next paper was presented by its author, Lieutenant A. M. Beecher, U. S. N., and was entitled "Wireless Telegraphy in the United States Navy." Lieutenant Beecher gave some account of the various wireless telegraph systems and briefly described what has actually been done in the United States Navy with reference to the use of this means of signaling and communication.

Lieutenant Harry George, U. S. N., then presented in abstract a long paper entitled "Electricity in the Navy." This really valuable paper took up the subject of the historical evolution of the application of electricity in our navy, and instituted a number of comparisons between American and the foreign navies regarding the nature and class of the equipment upon vessels of recent construction. The specifications in use by the navy department for the installation of electrical apparatus on shipboard are widely different from those in vogue for land work, and these were recited with considerable fulness for the general information of manufacturers and others. The paper contained many extremely interesting historical and other facts.

Captain Edgar Russel, U. S. A., of the Signal Corps, then presented in brief abstract a highly interesting paper entitled "The Military Cable System of the Philippines," illustrated with lantern slides. This paper is reprinted elsewhere in this issue.

Lieutenant W. V. N. Powelson, U. S. N., read a paper entitled "The Reasons for the Change of the Navy Standard Voltage from Eighty to One Hundred and Twenty-five Volts." Lieutenant Powelson's paper summarized the numerous reasons which had led the navy authorities to adopt originally the eighty-volt system, and since to change it to one more nearly in conformity with the commercial usage of the country. The principal reason leading to this decision was the ability to obtain commercial apparatus quickly.

Major George W. Goethals, U. S. A., then presented a very interesting summary of recent work in the electrical equipment of coast fortifications, entitled "Electricity in Permanent Seacoast Defence." Major Goethals's paper recited at length the interesting questions which had arisen, and gave numerous details of plants and systems installed along the Atlantic coast of the United States for the various purposes of lighting and power transmission at these fortresses.

Mr. Townsend Wolcott presented very briefly his paper upon "The Method of Submarine Cable Testing in the Signal Corps of the United States Army."

Mr. Walter M. McFarland, of Pittsburg, then delivered an abstract of his paper, entitled "Electricity in the Navy," which, while containing some historical data, was in the main an argument for the use of polyphase motors on shipboard for the various purposes to which electric motors of the direct-current type are now applied.

Dr. Louis Bell, who was down upon the programme for a paper, being absent, the last paper read was that of Lieutenant-Colonel Samuel Reber, U. S. A., entitled "Electricity in the Signal Corps." This interesting paper, which will appear in a later issue of the ELECTRICAL REVIEW, dealt with the applications of electricity in all the various departments of army signaling, both at fixed posts and in the field. In connection with it Lieutenant-Colonel Reber showed a number of highly interesting lantern slides exhibiting the work of the field telegraph service in the Philippine Islands, when often the end of the telegraph line was less than one hundred yards behind the line of battle in actual engagements.

The discussion was opened by Lieutenant-Colonel Reber, who spoke in terms of high compliment of Mr. Haskins's paper and of the importance of carrying out the suggestions contained in it. Lieutenant George spoke in much the same strain. He also discussed the question of duplicate dynamo rooms on modern ships of war, and gave a number of interesting instances of this practice in vessels of foreign navies.

Brigadier-General Eugene V. Griffin, U. S. V., who was present, was invited to speak. He spoke very entertainingly and at some length concerning the possibility of an organization of technical volunteers and the assistance they might offer the regular army. He spoke of the necessity which was experienced in time of war for the services of volunteers in the fighting line to expand our small standing army to the dimensions required. The same necessity existed in regard to the technical services as distinguished from the purely fighting line. The difficulty of improvising material for the signal or other technical corps was daily becoming greater, as the complexity and differentiation of apparatus increased. He

paid a high compliment to the emergency work of electrical manufacturers exhibited during the recent Spanish war, but in illustration of the utter impossibility of making some very requisite things in haste he told of how, after much cabling abroad, it took two weeks to get together in all Europe fifteen searchlight lenses. He hoped that the evening's meeting would lead to the formation of a volunteer electrical corps.

Mr. A. V. Abbott asked a number of questions concerning wireless telegraphy in the navy which were answered by Lieutenant Beecher. With coherer receivers, signaling at forty miles distance was accomplished, the lieutenant said, with a one and one-half-inch spark-gap. With the new receiver, due to Professor Reginald Fessenden, the spark-gaps for this distance of signaling were between one-quarter and one-half inch in length. He noted the interesting fact that it was harder to send wireless signals over fresh water than over salt, and very much harder to send them over land than over water of any kind. The best speed of signaling with the coherer was about twelve words per minute. With the telephone receiver now under test by the United States Navy, twenty-five words per minute had been accomplished, and the speed was limited only by the skill of the receiving operators. He had found the height of masts used for supporting the vertical conductors to be about in arithmetical ratio with the length of the transmission.

Colonel Reber said his experience with the coherer was that that instrument was unstable, and that experimental data concerning the heights of transmitting wires and the distances to which messages could be transmitted were unreliable because the coherers never acted twice alike.

Brigadier-General A. W. Greely, chief of the Signal Service, U. S. A., was present, and upon invitation of President Steinmetz addressed the Institute. He said, in part, that the spirit of cooperation between the Institute and the military service was wholly in accord with his own ideas. He hoped that the result of the discussion would be the formation of a valuable adjunct to the military branches of the government by the creation of interest in this class of work among the members of the Institute and other engineers. He felt sorry, he said, for the chief of a department who would attempt to do important technical work with his own corps when the same work could be far better done by civilians. With the latter the familiarity and experience gained by long practice under arduous competitive conditions had bred a degree of expertness which could not be attained by soldiers or sailors to whom such work was an incident. For example, he had never allowed his department to lay cables where he could get the work done by civilians who knew better how to do it. He spoke of the relations between the regular army and the volunteers. The regular soldier, he said, is simply a professional and harder working volunteer. When Congress shall allow selection, competition and elimination to be exercised in the army, the results he believed would be as satisfactory as they had been in the world of affairs outside. When the reorganization of the volunteer army takes place along these lines it will be a highly valuable arm. General Greely quoted Von Moltke, who said that "war is the science that lays all the other sciences under tribute." He considered that the use of electrical and other engineering inventions and methods was one of the most important—if not the most important—factor in the advance of the efficiency of the army, and hence a duty of patriotism. Even more vital in the army than in civil life is the use of electrical methods. We had seen in a few years what electrical engineering applications could do for the advance of civilization and the betterment of conditions of life in cities and in the country generally. Even more than this could be done proportionately in the army and in the navy by the use of the same appliances, the same methods and the same degree of technical skill. General Greely's remarks were warmly applauded.

Mr. Calvin W. Rice, on behalf of the committee on papers, thanked the officers of the military services for the papers and remarks that had been made. After very short and desultory further discussion the meeting adjourned at a late hour.

THE MILITARY CABLE SYSTEM OF THE PHILIPPINES.

BY CAPTAIN EDGAR RUSSEL, SIGNAL CORPS, UNITED STATES ARMY.

After the progress of negotiations of the Commission at Paris in November, 1898, had made it certain that the retention of the Philippines would be recommended, steps were immediately taken by General A. W. Greely, the chief signal officer of the army, to provide for inter-island communications which his forecast of coming conditions indicated would be necessary. With this in view, arrangements were made for the purchase of cable and the fitting out of a suitable ship for cable laying.

It should be stated that at this time there were no government cables in the Philippine archipelago, and but one commercial cable system, about 600 miles long, that of the Eastern Extension Telegraph Company, which connected Manila, Luzon, with Iloilo, Panay; Bacalod, Negros; and Cebu, Cebu. There were no Spanish land lines except on the island of Luzon, and these, falling into the hands of the insurgents in a deteriorated condition, went to pieces and required replacement by the Signal Corps. It may thus be said that no telegraph system existed in the islands apart from the single commercial cable system mentioned above.

As soon as the treaty of peace had been ratified, in February, 1899, the contract was let for the manufacture of 212 miles of cable, and the army transport Hooker was fitted out as a cableship. The supervision of all matters connected with the manufacture, loading and subsequent care of the cable was entrusted to a Signal Corps officer, Major Joseph E. Maxfield.

The Hooker arrived at Manila in July, 1899, but cable laying being delayed, was sent by the Quartermaster's Department to Hong Kong, and on her way out of Manila Bay was wrecked. By the most strenuous efforts of the signal officers all the cable machinery and instruments and most of the cable were taken off. A few months later the Signal Corps made its first essay in deep-sea cable laying in the Philippines. The cable machinery and the cable from the Hooker were put on a small coasting steamer chartered at Manila, and in the autumn of 1899 two stretches of cable were laid, one connecting the islands of Layte and Cebu, and the other the towns of Pasacao and Guinayangan on the west coast of Luzon. The subsequent use made of these cables and their great importance in the general scheme of communication have fully justified the original venture and emphasized the excellent work done in overcoming the obstacles presented by the wrecking of the Hooker.

The rapid spread of the American occupation in the southern islands of the archipelago soon made further provision necessary, and in the spring of 1900 active preparations were made for further extension of the cables. Seeing that a long period of cable laying was in prospect General Greely, the chief signal officer of the army, requested that a transport be assigned for that purpose. The transport Burnside was selected, was thoroughly overhauled and refitted for use as a cableship. Three cable tanks were put

in, a testing room was built, and the forward deck was prepared for the placing of cable machinery as soon as the vessel arrived at Manila. Five hundred and fifty-three miles of deep-sea cable and eight miles of shore end were put aboard in New York. The Burnside arrived at Manila early in December, 1900, and was immediately fitted with the cable machinery originally sent out with the Hooker.

As this was the first deep-sea cable laying ever done by a ship regularly fitted out for that purpose by this government, it may be interesting to describe personnel and material somewhat fully. The chief signal officer of the Division of the Philippines Lieutenant-Colonel James Allen, Signal Corps, afterward Brigadier-General of Volunteers, was in charge of cable operations. He was assisted by a staff of five signal officers, Captains George O. Squiers and Edgar Russel and Lieutenants Henry S. Hathaway, Frederick W. Jones and Earle W. Binkley and two civilian experts, Mr. T. A. Hamilton, cable electrician, who had previous distinguished service with commercial companies, and Mr. Henry Winter, cable engineer, who also had great experience in cable laying and repairing. Seven enlisted men of the Signal Corps were regularly on board, a number of others being left as operators at various stations. Thirty-six natives were employed as laborers, their duties being mainly in the tanks during cable laying. The ship's officers and crew, and the supply departments, were under charge of an officer of the Quartermaster's Department, Major J. C. W. Brooks. The division of technical duties among the officers on board was made at once, although all took turns at watch at various important points when cable laying was in progress. As the duties were new to most of the officers and men, no opportunity for drill and instruction was lost, and, when once started, the work being almost incessant, great progress was made in a surprisingly short time.

The take-up gear used was made in New York. The cable coming up from the main tank through a bell mouth over the centre passed over a fair lead, or sheave, and thence three or four times around the drum of the take-up gear, then through the dynamometer, and finally over either the bow or stern sheaves, circumstances determining whether cable should be laid over bow or stern. The testing room was fitted with an excellent assortment of instruments. Standard bridges, condensers, shunt boxes, discharge and reversing keys, excellent galvanometers of the Sullivan and Thompson marine patterns and testing batteries were provided. The high-insulation leads to the cable tanks were brought into the testing room in a secure and convenient way. The lower ends were fastened in boxes near the tanks, the terminals being kept dry by an electric lamp in each box.

During cable laying an officer was constantly on the bridge taking locations by

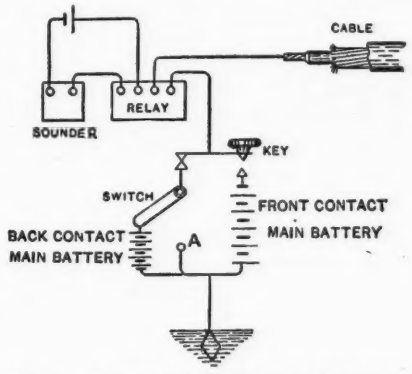


FIG. 1.—OPEN CIRCUIT—DOUBLE CURRENT.

sextant or compass observations every fifteen minutes. Another officer was in the cable tanks incessantly, watching the native laborers, and provided with an electric signal for "full speed astern" in case a kink or snarl started up out of the tank beyond the control of the helpers. Another took general supervision of the machinery, seeing that proper amounts of water were used, and that all sheaves were kept oiled, the dynamometer closely observed, etc. The methods of getting the cable end ashore depended entirely on the pecu-

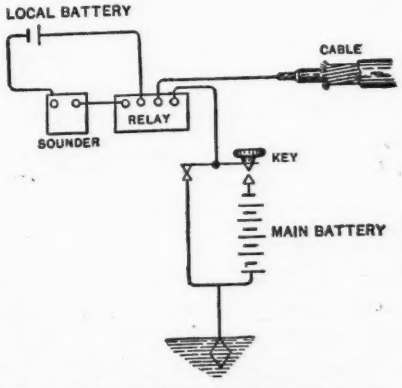


FIG. 2.—OPEN CIRCUIT—SINGLE CURRENT.

liarities of the landing. Usually small boats in tandem, supporting the cable at intervals, were hauled shoreward by a rope running from the leading boat to a sheave secured on the beach, and thence back to a steam winch on the ship. Meantime, while the shore end was being landed and trenched up to the office or cable hut, the officer in charge of the office installation was engaged in constructing shelves and tables and setting up batteries and instruments.

Many of the Philippine cable stations were shared by soldiers of the garrison. In few cases was the white population other than military, and in some stations the cables were laid at a time when the sound of firing was not an infrequent accompaniment to the click of the office instruments. Many of the routes over which cables were laid were very imperfectly charted. In laying the cable from Iligan to Misamis, for example, along northern Mindanao, an error of over five miles in a charted distance of twenty-five miles was discovered. This, taken in conjunction with numerous uncharted rocks and shoals and the absence of any shore lights, made navigation especially hazardous.

Owing to this uncertainty and the meagreness or absence of soundings, it was necessary to precede each stretch of cable laying with a line of soundings. The Sigsbee sounding machine, utilizing piano wire and an iron detachable sinker, was used. The deepest soundings obtained were south of Mindanao when the line went down over 1,200 fathoms. The heavy iron sinker failing to be detached, was brought up icy cold from this depth by the rapid little take-up gear attached to the sounding machine, an interesting exemplification of the fact that deep-sea temperatures are alike in torrid or frigid zones.

The first stretch of cable laid was that connecting Dumaguete, on the island of Negros, with Misamis, on the north coast of Mindanao, ninety-eight nautical miles. All went well during the first thirty miles of laying, when a sudden "foul flake" appeared, carrying a mass of tangled cable up to the cable machinery and blocking it; although "full speed astern" was instantly signaled, the officer on watch sorrowfully noted the steady rise of the dynamometer until the 7,000-pound mark was reached, when the cable snapped and the end went overboard. Soundings were quickly taken and a mark buoy was soon placed. Four hundred fathoms was the depth at this point. The ship then went back about a mile, the grappling gear was lowered and slow dragging across our course was begun. The cable was soon caught, as indicated by the dynamometer, carefully raised, the bight cut and the end brought on deck. A test showed "all right," communications with the men on watch in the cable hut at Misamis being at once obtained. The splicing experts proceeded to splice the end to that of the cable in the main tank, the splice was lowered, and, seven hours

after the accident, we were again under way, completing the laying of the cable without other incident. No accident exactly similar to this occurred in laying subsequent cables, but every other accident known to the profession did occur. Even an earthquake with a subaqueous landslide as a cable destroyer was provided for our especial benefit. So, in-

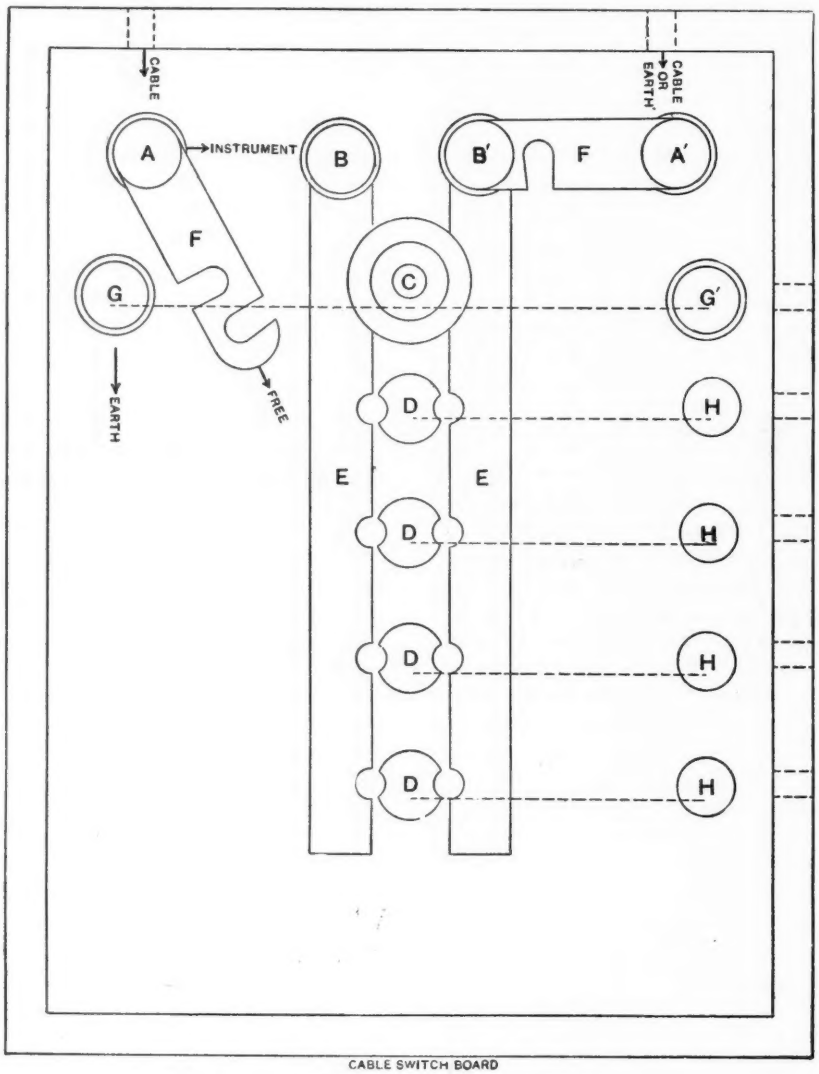


FIG. 3.—SWITCHBOARD FOR SMALL STATION.

struction to the inexperienced was thorough, for thanks to a very capable engineer and the keen interest and hearty cooperation of all, every difficulty was successfully overcome.

On these lonely coasts many expedients were resorted to where difficult landings had to be made or cables were to be laid in shallow waters. One of these cases was the laying of a cable from Misamis south about twenty miles into Panguil Bay, a shallow body of water which nearly cuts the island of Mindanao in two at this place. The ship could not get any further than Misamis, so two native boats, called bancas, were hired, and the boats and outriggers were floored over. Cable was coiled on these and taken up the bay and river by the ship's launches. The landing was at a deserted place in the Moro country called Lintogup. Here a cable hut was built, and, after many tribulations, the cable was laid back to Misamis, only to find that a fault had developed at the other end during the laying. Another weary repair journey across the treacherous wind-swept shallows had to be made. A land line connects the lonely hut at Lintogup with the cable station Tucuran on the south side of the Mindanao isthmus. From this point the cable goes to Zamboango.

Another coast cable has recently been laid connecting Tucuran with Malabang and Parang Parang. This is the country of the Moro savages whom our soldiers have been compelled to chastise because of their failure to make restitution for robbery and the murder of Americans. The incalculable saving of time made by this complete system of cables connecting these places on Mindanao with department headquarters at Cebu and district headquarters at Zamboango would be hard to estimate. Owing to the great distance from Manila, the supply departments would otherwise scarcely have been able to cope with the sudden demands made on them.

In the cable stations two methods of open-circuit Morse working were used—the single and double-current methods. In both, polarized relays were employed. An inspection of the diagrams (Figs. 1 and 2) shows the methods of connecting up. In only one of the cables where the length was over 150 miles was it found that the "k. r." was sufficient to make any troublesome drag in sending at moderate speeds by the single-current method. At first the ordinary telegraph switchboards were used. But whenever testing had to be done the imperfect insulation given by these switchboards made the operations of "earthing," "freeing" and "cutting through" somewhat unreliable. Another form of switchboard for small stations has been devised. It is shown in the illustration (Fig. 3). It consists of a hard rubber base on which are placed the ordinary straps, buttons and binding-posts for a two-wire board. In addition two revolving slotted copper strips are shown for making connections, placing the cable to "instruments," "earth" or "free." The whole is fitted with a glass door and wooden cover of sufficient depth to admit placing a small cup of desiccating material within when cable testing is going on.

(To be continued.)

Wisconsin State Independent Telephone Association.

The Independent Telephone Association of the State of Wisconsin will hold a meeting June 25 and 26 at Waupaca, Wis., at which a number of important papers will be read, and much other business usually incident to such conventions will be transacted. This is one of the most vigorous and important of the state telephone associations, and has already succeeded in doing excellent work in behalf of its membership. Mr. H. C. Winter, of Madison, Wis., is the secretary.

Railway Telegraph Superintendents' Association.

At Chicago, on June 18 to 20, the Railway Telegraph Superintendents' Association of the United States will hold its annual convention. Mr. P. W. Drew, of the Central Railway Company, of Milwaukee, Wis., is secretary of the organization, and can furnish full information regarding the programme and meetings.

WHAT EFFICIENCY LAMP SHOULD BE USED, AND HOW MAY THIS EFFICIENCY BE DETERMINED FOR ANY PARTICULAR STATION?—III.

A DISCUSSION BY HENRY L. DOHERTY, SAMUEL E. DOANE, L. G. VAN NESS AND FRANCIS W. WILLCOX.

THE EFFECT ON RATES.

As this question largely concerns the question of rates, we might find it of interest to consider how the adoption of the high-efficiency 3.1-watt lamp, in place of a lower-efficiency lamp, affects results under the different systems of rates in force; also how the central station can cover the extra lamp-renewal cost.

Our considerations and conclusions, as stated in the beginning, are based only on meter rates. On flat rates it is obvious that the basis of sales is the lamp month, and therefore, as with a lamp-hour basis, the efficiency giving lowest operating cost should be used, modified by the consideration that a high-efficiency lamp increases the number of lamps (and consequently the income) per kilowatt of capacity.

The supply of lamps of a higher efficiency is equivalent to a reduction in rates varying with quantity consumed, or on the "two-rate meter" system, the adoption of high-efficiency lamps would have the same effect as a reduction in the rates. Whether or not it would increase the use of light to the point of improving the net earnings would depend upon how much influence the knowledge that a high-efficiency lamp was used would have on the consumer burning his lamps. I should say it would have a stimulating influence. The evidence of this is the improved returns that the installation of lower units of candle-power has effected and the marked improvement in the gas business with the introduction of Welsbach burners.

As regards meter rates with a minimum guarantee, the same conditions apply, with the added advantage that the guarantee can be slightly increased to cover additional cost of lamp renewals.

A generally accepted system of rates is the one providing for the two charges that constitute the cost of supply; that is, the "readiness-to-serve" charge and the "operating" charge. The first charge is covered either by a minimum guarantee per lamp demanded (Mr. Doherty's system), or by charging a high rate for the first one to two hours' use per unit per day (Mr. Dow's system), or by charging a high rate for a given number of hours' use of the maximum demand (the Wright demand system), or by charging a high rate for a given number of hours' use of the maximum capacity of installation (New York system), etc.

The second charge, to cover "operating" cost, is uniformly made by allowing a low rate (generally half the first rate) for all additional current used in excess of that charged for at the high rate.

The general effect of the adoption of a high-efficiency in place of a low-efficiency lamp in all these cases will be to increase the number of units per kilowatt of station capacity. It should therefore increase the gross high-rate revenue on Mr. Dow's system and the New York system.

The consumer's appreciation of the fact that he is supplied with a high-efficiency lamp should have a tendency to make him more liberal in the use of lamps, and thereby increase the number of lamps demanded, or the maximum number used, and thus enlarge the high-rate revenue on both Mr. Doherty's and the Wright demand system.

In all these cases, then, we see that the use of high-efficiency lamps improves the high-rate revenue income per kilowatt of capacity (covering readiness-to-serve cost), and this offsets in a measure the increased cost of lamp renewals. In any case, a slight addition can be made to the price per lamp demanded or increase of number of hours for which units installed, maximum demand, etc., is charged, thus securing an increase in the readiness-to-serve charge to cover fully additional lamp-renewal cost of high-efficiency lamps. In other words, these systems of rates are so flexible as to permit of readily covering the additional lamp-renewal cost to station (with high-efficiency lamps) in the readiness-to-serve charge. All objections are thus removed to adopting the high-efficiency lamps our theory requires.

HOW LAMP-RENEWAL COST MAY BE OFFSET.

Looked at in another way, it is as if the station manager should say: "We find it of considerable advantage to be able to provide light so that the cost to our customers will be a minimum. This requires the use of a 3.1-watt lamp. We do not want to increase operating costs by the adoption of a 3.1-watt lamp in place of the 3.5 or four-watt lamp heretofore supplied. We do not deem it desirable to attempt to increase our kilowatt-hour rate to cover this increased cost. We find our consumer will not use a 3.1-watt lamp and pay for it direct, although such a lamp, even with its price added, gives light at a less cost than a 3.5 or four-watt lamp when supplied free. We find that the consumer, if made to buy his own lamps, will invariably use some lower efficiency than 3.1 watts. Consumers will not even pay directly simple increase of lamp-renewal costs for 3.1-watt lamps. We will, therefore, make consumers pay it indirectly by a slight modification of our readiness-to-serve charge."

This involves no change in kilowatt-hour rates, and is therefore not apparent to the consumer, who, nevertheless, is thus made to contribute for the supply of the lamp it is to his interest to use, and which will save him on his service many times the charge he unwittingly pays therefor. This plan is, I know, not correct theory as concerns rates, since lamp renewals are an "operating," not a "readiness-to-serve" cost. It, however, solves the difficulty where it is not possible to increase the kilowatt-hour rates. I am even bold enough to suggest this as a means of covering the full cost of free renewals for stations that are guilty of making consumers buy their own lamps from supply stores, hardware stores, etc., and that plead in extenuation that they can not afford to supply free renewals on account of the cost.

It would be the more correct basis, I admit, to increase the kilowatt-hour rate by the fraction of a cent that the cost of lamp renewals represent. (See curve II, Fig. 1.) This has been done in some cases and should be done in all, but many stations either lack the courage to do it, or find it inadvisable or impractical. The other plan, therefore, is proposed. Its working is covered up and is not directly apparent, and thus should be generally feasible, as it is not open to the objection of a direct change in the rate. I can hardly lay too much stress on the necessity of free renewals, since without free renewals or complete lamp control this whole discussion is useless, and this must not be forgotten.

The effect of a high-efficiency lamp on returns from the low-rate charge covering operating cost should be the same as that given by the low-rate charge itself, *i. e.*, a liberal use of light. This is because, as before stated, the supply of a high instead of a low-efficiency lamp is equivalent to a reduction of rates. The low-rate charges that cover operating costs do not go, as a rule, below four cents per kilowatt-hour, so that even on this part of the charge our efficiency determined (3.1-watt) is the proper one.

For special classes of business, like isolated plants taken on the service where current is supplied at a very low rate per kilowatt-hour (three cents or lower) it is desirable to compromise on the lamp-

renewal question by making the consumer pay for lamps, but charging him only cost or below cost therefor. In such a case, of course, the lamp efficiency giving the minimum cost to user at the rate given should be used.

THE CASE OF OTHER UNITS THAN SIXTEEN CANDLE-POWER.

It was expected several years ago that the standard unit would tend to grow larger and the twenty-candle-power lamp gradually take the place of the sixteen candle-power. Practice has, however, followed the opposite course, and the use of units lower than sixteen candle-power is growing extensively. This is as it should be, for the best economy of lighting results, permitting as it does a better distribution with increase in number of lamps available. It is not at all improbable that in a few years the standard candle-power unit in this country may be the same that

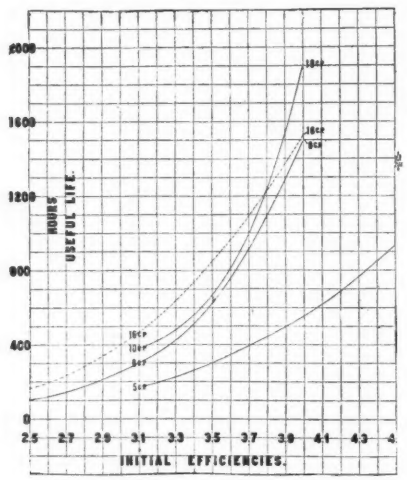


FIG. 3—Curves of useful life of the sixteen, ten, eight and five-candle-power, 100-volt to 125-volt lamps at various initial efficiencies.

it is in Europe to-day, *i. e.*, the eight-candle-power lamp. It is still more probable; I think, that these lower units—ten candle-power, eight candle-power, etc.—will be used in place of a higher efficiency sixteen-candle-power lamp than the present 3.1-watt efficiency. The introduction of lower candle-power units than sixteen is very likely in its results to the introduction of sixteen-candle-power lamps of higher efficiency. These low-candle-power units have been of immense value to central stations in securing and holding business in residences and elsewhere, and their large, rapidly growing and successful use attest the value of the argument I have advanced in this paper, namely, that it pays for central stations to secure their consumers the greatest economy in the costs of lighting service, just as gas companies are doing with the Welsbach lamp.

The determination of the best efficiency of these lower candle-power units forms a most interesting question, hardly second to that of the sixteen-candle-power lamp.

DIFFERENCE IN LIFE BETWEEN SIXTEEN CANDLE-POWER AND THE LOWER CANDLE-POWER UNITS.

In the first place, it must be noted that the lower candle-power units have a shorter life than the sixteen-candle-

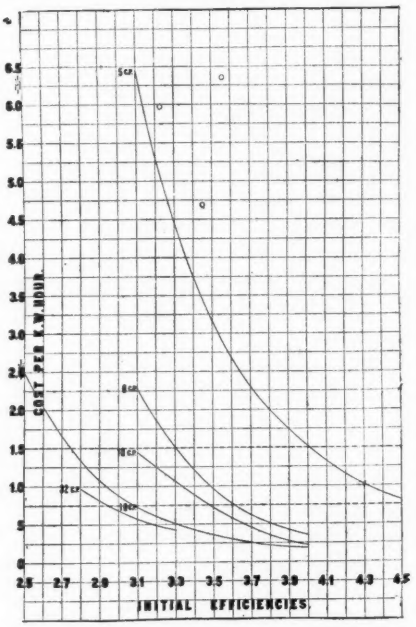


FIG. 4—Curves giving cost per kilowatt-hour for the five, eight, ten, sixteen and thirty-two candle-power, 100-volt to 125-volt lamps (renewed at end of useful life).

power lamp of the same efficiency. For the same efficiency, the life decreases with the reduction in the candle-power unit. This is shown in the following table (table II), which gives the useful life of the various candle-power units and the cost of lamp renewals per kilowatt-hour. These values are plotted in curves in Figs. 3 and 4.

TABLE II

USEFUL LIFE AND LAMP-RENEWAL COSTS PER KILOWATT HOUR FOR VARIOUS CANDLE POWERS OF 100-VOLT TO 125-VOLT LAMPS AT VARIOUS INITIAL EFFICIENCIES. LAMPS RENEWED AT END OF USEFUL LIFE. LAMP PRICES TAKEN 17 CENTS FOR 5, 8, 10 AND 16-CANDLE-POWER 26 CENTS FOR 32-CANDLE-POWER.

Efficiency in watts per candle	5-Cp. Lamp		8-Cp. lamp		10-Cp. lamp		16-Cp. lamp		32-Cp. lamp	
	Useful life in hours	Kw.-hr. cost in cents	Useful life in hours	Kw.-hr. cost in cents	Useful life in hours	Kw.-hr. cost in cents	Useful life in hours	Kw.-hr. cost in cents	Useful life in hours	Kw.-hr. cost in cents
2.5							166	2.5		
2.6							200	2.04		
2.7							236	1.66		
2.8							282	1.35	270	0.97
2.9			215				336	1.06	322	0.81
3.0			255				400	0.88	382	0.70
3.1	170	0.45	300	2.88	380	1.44	470	0.73	450	0.58
3.2	200	5.35	355	1.87	422	1.06	550	0.60	526	0.50
3.3	231	4.46	425	1.51	480	1.07	639	0.50	612	0.43
3.4	269	3.75	515	1.21	560	0.88	738	0.42	706	0.37
3.5	306	3.17	625	0.97	668	0.72	846	0.36		
3.6	348	2.7	760	0.78	810	0.58	967	0.30		
3.7	394	2.3	945	0.62	992	0.48	1,090	0.26		
3.8	444	2.0	1,090	0.51	1,235	0.36	1,227	0.23		
3.9	496	1.76	1,285	0.14	1,543	0.29	1,374	0.20		
4.0	550	1.54	1,500	0.35	1,910	0.22	1,500	0.18		
4.1	629	1.38	1,700							
4.2	697	1.16	1,900							
4.3	773	1.02								
4.4	850	0.91								
4.5	935	0.81								

Since the price of all lamps is the same as that of the sixteen-candle-power, there is a limit in efficiency with low candle-power units at which the station can afford to supply the lamp free. The income given during a life the same as the sixteen-candle-power bears too small proportion to the cost of the lamps. The following table gives information on this point:

TABLE III

COST OF LAMP RENEWALS WITH DATA AS TO LIFE, REVENUE RETURNED, ETC., FOR CANDLE-POWER UNITS BELOW SIXTEEN CANDLE POWER

Class of lamp	Total watts per lamp	Useful life in hours	Cost of lamp renewals for 1,000 hours' service (Lamp price taken at 17c.)	Income returned per lamp for 1,000 hours use at 10c per kw. hr.	Per cent of cost of lamp renewals to income returned for 1,000 hours use at 10c per kw.-hr.
5-Cp. 4-wpc	21	550	$0.31	$2.10	15
8-Cp. 3.1-wpc.	25	500	0.34	2.50	13.5
8-Cp., 3.6-wpc	28.5	760	0.22	2.85	7
8-Cp., 4-wpc	33	1,500	0.11	3.30	3.333
10-Cp., 3.1-wpc.	31	380	0.45	3.10	14.5
10-Cp., 3.6-wpc	36	780	0.22	3.60	6
10-Cp., 4-wpc.	40	1,900	0.09	4.00	2.25
16-Cp., 3.1-wpc	50	470	0.36	5.00	7

The efficiency that gives equal life to that of the sixteen-candle-power lamp can therefore hardly be taken as the basis for low candle-power units.

It has been suggested to reduce the useful life limit from eighty per cent to seventy per cent or lower, allowing lamps to burn to the end of their full natural life and thus reduce the cost of renewals. The natural average life of such lamps is, however, just about the same as the useful life for practically all efficiencies higher than 3.6 watts per candle, so that there is no increase of life available.

THE BASIS OF EQUAL LAMP COSTS PER KILOWATT-HOUR.

The most satisfactory plan would seem to be to adopt that efficiency which makes the costs per kilowatt-hour for any unit the same as the sixteen-candle-power lamp selected. From the costs given in table II and curves in Fig. 4, we can quite readily determine this. This gives us an efficiency of 3.6 watts per candle for the eight and ten-candle-power lamps and below four watts for the five-candle-power lamps. I have included the higher candle-power unit up to thirty-two candle-power on this diagram, and we see they should have the same efficiency as the sixteen-candle. The adoption of low efficiency for low candle-power units affects costs per lamp to consumers much less than with sixteen-candle-power lamps; there is, therefore, less objection to the use of 3.5 and four-watt efficiency in these units.

THE EIGHT-CANDLE-POWER LAMP.

Were the eight-candle-power lamp the standard unit in this country instead of the sixteen-candle-power, as it is in Europe, we should then deduce the desirable efficiency on the same basis that we have adopted for the sixteen-candle-power

lamp. The curves in diagram Fig. 5 give the efficiencies that will secure the minimum cost of light similarly to the results of the sixteen-candle-power lamps given in Fig. 2. This points to the 3.6-watt lamp, or better, as the desirable one, considering the matter in regard to rates and conditions of service in the same way as we have the results for the sixteen-candle-power efficiency.

THE LOWEST UNITS OF CANDLE-POWER.

For the smaller units of five, four, three and two candle-power extended consideration is not necessary, since they are as yet generally used only for two purposes—sign lighting and closet and cellar lighting in residences. For the latter service they are a pure convenience to the user and therefore of value to the central station company only in popularizing electric lighting and aiding its introduction into residences, etc.

THE CASE OF SIGN LAMPS.

In sign lighting a good number of lamps are always used together, a condition that allows greater liberality in lamp renewals and in efficiency to be chosen, etc., than would be the case for general service with lamps used individually or in smaller groups. The efficiency of such lamps in sign lighting must be high enough to secure the effect of point and brilliancy, avoiding the reddish tinge which gives a dim, dull appearance. To this end we must accept a higher efficiency and shorter life than the basis of equal costs per kilowatt-hour with sixteen-candle-power lamps would give us. Experience shows that a three or four-candle-power lamp, when used at approximately four watts per candle efficiency, gives very satisfactory service in sign lighting. Their life will average 600 hours, and they give the desired brilliancy.

GENERAL CONCLUSION.

In general, then, we have the following conclusion:

First—The best available efficiency in central station service for the sixteen-candle-power lamp is 3.1 watts per candle. Actually, the 2.75-watt lamp is the desirable one for average rates in use.

Second—The 3.1-watt lamps can be used to advantage even when the voltage is kept four per cent high with fluctuations going still higher.

Third—There should, therefore, be no central station which supplies current by meters using any lower efficiency than the 3.1-watt lamp in sixteen candle-power.

Fourth—The best efficiency in smaller candle-power units is that which keeps the cost per kilowatt-hour renewals about the same as the sixteen-candle-power costs. The basis gives a 3.6-watt-per-candle efficiency, or better, for eight and ten-candle-power lamps.

Fifth—Very low candle-power units, being used chiefly for sign lighting, can be more liberally treated than the basis in paragraph fourth demands. An efficiency of four watts per candle is desirable for the four and five-candle-power units, reducing this to five watts per candle for the three and two-candle-power lamps, owing to the extreme fineness of filament in so small a unit.

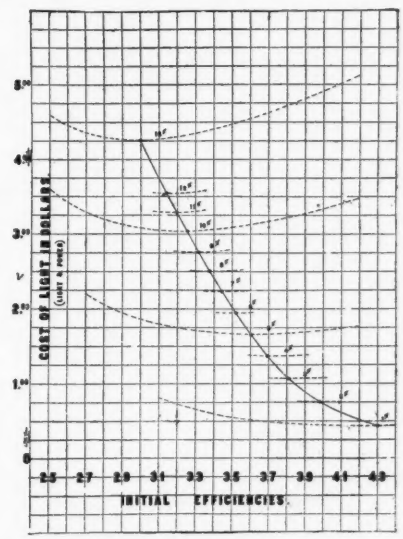


FIG. 5—Minimum-cost-of-light curves for eight-candle-power lamps at various efficiencies and different rates for power (lamp price taken seventeen cents and renewals made at end of useful life corresponding to each efficiency). Dotted horizontal curves give total cost of light (lamp and power) at different rates.

Trolley Road Wanted.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

I have been requested to write you by a meeting of the business men of Dickson County, Tenn., with a view to obtaining your kind assistance in the promotion of an electric railway through said county.

Our people desire a line, commencing at Dickson, Tenn., on the N. C. & St. L. Railway, and running through Charlotte, the county site, and Cumberland Furnace, to a point on the Cumberland River, a distance of from twenty-four to twenty-eight miles, according to route decided on.

Dickson is a town of nearly 2,500 inhabitants, with two large stove plants, two axe-handle plants, a brick plant, roller mill and planing mill. Charlotte has a population of about 500, with roller mill, sawmill and machine shop in contemplation.

Cumberland Furnace, as the name implies, is a furnace town with a seventy-five-ton furnace in operation and touched by a spur of the L. & N. Railroad. The proposed electric line would pass through a good farming country, at present devoid of railroad facilities; corn, tobacco, wheat and fruits are the chief products. The country is full of iron ores, and a fine quality of limestone. The people will give rights of way and the cross-ties toward building the road. The grades are easy, and there are no streams of any size to be bridged.

We want to get in communication with parties who have the capital to put such a road in operation. It might be added that the franchises to supply light and power to the towns mentioned could be obtained for those operating the proposed road.

We should be glad to hear from you, and will cheerfully consider any suggestions you may be pleased to give us, and trust that you will give this matter publicity, and if possible put us in touch with the necessary capital.

There will be another meeting of our people at Charlotte, Tenn., June 2, 1902, to report progress made and the interchange of ideas on the subject.

GRAHAM EGERTON.

Charlotte, Tenn., May 19.

Convention of the Master Car-Builders' Association.

The convention of the Master Car Builders, the Railway Master Mechanics and the Railroad Supply Men's associations will all be held at Saratoga Springs, N. Y., in the week of June 18 to 25. A large attendance is already assured, and it is expected that the usual number of valuable and interesting papers will be presented.

The volume and fall of water in coast streams is a subject that is being given considerable deserved attention. Their utilization for electrical purposes is one of the foremost factors in present development. In this regard it is to be observed that the greatest accuracy and most complete detail is necessary in all experimental work with a view to determining practical value. Particularly is this the case in relation to the lessened summer flow. The minimum rather than the maximum flow should be the special object of information. While storage naturally enters into all final calculations, yet the costly experience with hastily constructed electrical work makes manifest the need of care and accuracy in all determinations of this kind where investment of capital is contemplated.

News from Great Britain.

(By Our Special Correspondent.)

ON MAY 1 the Wolverhampton Art and Industrial Exhibition was opened under much less pretentious conditions than the Glasgow Exhibition this time last year. Nevertheless, from an electrical point of view there is much to interest, and inasmuch as Mr. H. A. Hadley, who acted in the capacity of manager to the Glasgow Exhibition, is also to be found in the same rôle at Wolverhampton, nothing in the management should tend to an unsuccessful run. For the electric supply a three-wire, continuous-current system is utilized. Five boilers, representing a total of 5,000 horse-power, are to be found in the power-house and eight generators. Brockie Sell arcs and Edison incandescents light the buildings and grounds, and in addition there are some Bremer arc lamps and "Rex" arc lamps, the latter made by Messrs. Hiram Maxim & Company. As at Glasgow, a good deal of aluminum wire is utilized for outside work. Altogether the arcs number 360 and the incandescents, 8,000. All the generating machinery is of British manufacture. The main buildings include an Industrial Hall and Machinery Hall. Over thirty acres of land are taken up, and the buildings will be outlined at night by white and green lamps.

The "tube" bills which are now before Parliamentary committees in such profusion are being prominently kept before the public just at present owing chiefly to the fact that Mr. Yerkes and Mr. Morgan are vigorously opposing each other in order to serve the same part of London—in other words, practically the whole of it. Mr. Morgan has a strong hand by reason of his having secured an important ally in the London United Electric Tramways Company, with whom a working arrangement has been entered into which, if Mr. Morgan's proposed tube railways are sanctioned, will admit of a communication never before known in the history of London—*viz.*, from north to west *via* the city without change and thence fifteen miles further to the west by the trams with only one ticket for the entire journey; and also from the south main steam railways to the termini of the main north country steam lines of England. What Mr. Yerkes proposes to do is by means of short junction lines, practically connecting the Circle and its adjuncts, which, while giving a most complete service, will necessitate numerous changes, and in view of the characteristic American "hurry" it sounds ironical to hear Mr. Yerkes advocating interchange railways so emphatically as against out and out through communication. However, the fate of either the Morgan or the Yerkes lines is not yet known, as upon one line of route the Central London Railway Company and another projected company are also opposing, and the task before Lord Windsor and his committee is no light one. Already ten sittings have been held and the proceedings before this particular committee alone are likely to last another month at least.

The annual motor car exhibition of the Automobile Club of Great Britain has been held and once again a grand success has been scored by steam and petrol cars, but the number of electrical cars, as usual, was out of all comparison with the others. To make matters worse there seems a decided antipathy to giving information on the part of some of the exhibitors of electrical cars, and this treatment of the press is likely to lead to little good. The same grievance was commented upon in the electrical papers over here last year.

The order for the tram cars for the London County Council's conduit tramways, which are now being built, has been placed with Messrs. Dick, Kerr & Company. The seating capacity of these cars, of which 100 have been ordered, will be twenty-eight inside and thirty-eight outside. The price of the successful tender was £71,754, but a condition is that they will be allowed to sublet to Messrs. J. G. Brill & Company, of Philadelphia, for the trucks, to the Electric Railway and Tramway Carriage Works for the car bodies, to Messrs. J. G. White & Company for the plows and to the English Electrical Manufacturing Company for the electrical equipment. It should be mentioned, however, that the Electric Railway and Tramway Carriage Works and the English Electrical Manufacturing Company are two subsidiary companies for which Messrs. Dick, Kerr & Company are sole selling agents. All these cars will be used for the South London Tramways. Dr. A. B. W. Kennedy, the council's consulting engineer, who expressed in favor of Messrs. Dick, Kerr & Company, which have tendered higher than the British Thomson-Houston Company, did so chiefly on account of what he considers the higher efficiency of the former's motors, which far outbalanced the difference in cost, he said. Two German firms which quoted, Messrs. Siemens & Halske and the Britisn Schuckert Company, were lower down in the list.

After a large number of attempts, the London County Council has at last succeeded in getting a bill past the first stage of its Parliamentary career, providing for the construction of a tramway along the Thames Embankment, that fine open thoroughfare depicted in these notes a few weeks ago in connection with the arc lamp standards which have been erected. The Embankment seems specially suitable for a means—and a pleasant one—of communication alongside the Thames, but a deal of opposition, based upon what might vulgarly be called "sentimental tommy-rot," was encountered and successfully overcome.

Yet another matter in connection with the London County Council, but in which it has not been so successful, is its bill enabling it to supply electrical energy in bulk to local authorities and to confer further powers in respect of the purchase of the statutory electricity supply undertakings in London by the local authorities. One of the main points emphasized in this bill was in relation to the law which enables a local authority to purchase so much of an undertaking within its district. In a number of cases this merely leaves the local body the network of mains, as the generating station is in another parish, and the council sought to remedy this state of affairs. The bill further sought to enable local bodies to combine to purchase. However, inasmuch as the bill is thrown out for this session, there is no need to go into further detail.

A legal case of more than ordinary interest is that taken by one of the London borough councils against the local gas company for damages to the former's electric light mains by an explosion of coal gas. A good many instances of this kind have happened of late years in England, but nobody has ever yet gone to the extent of testing the legal liability of the gas company. The actual facts are that a leakage of gas from the gas mains found its way into an electric light surface box

where it exploded and promptly blew off the cover of the box and also injured the connections, etc., inside. The borough council in question got its case as well as its damages, but the gas company is to appeal, and the last is apparently not heard of the matter.

Definite particulars have now been given *apropos* of the International Tramways Congress, which is to be held this year in conjunction with the International Light Railway Exhibition at the Agricultural Hall, London. The formal opening of the congress will be held on Monday, June 30, on which day the exhibition will also be opened to the public. On the following three days meetings will be held in the mornings and excursions in the afternoons, and in the evening of July 5 a banquet will be given.

The Institution of Electrical Engineers, which has just appointed Mr. James Swinburne to the presidency for the ensuing year, has been doing good work this session in the appointment of committees to look after the interests of the profession in various directions. Among these committees was one, formed on the suggestion of Mr. Robert Hammond, which had for its object the drafting of a set of model general conditions for use in connection with contracts for plant, mains and apparatus for electricity works. At the request of the committee, which was formed in December, 1900, the Electrical Plant Manufacturers' Association, the Cable Manufacturers' Association, the Municipal Electrical Association and the Engineering Employers' Federation appointed delegates to confer with it. The result of the deliberations of all these gentlemen has resulted in the publishing of a set of general conditions as mentioned above and which are being discussed by the members. This discussion has already been opened and bids fair to continue to a good length, and the final result—the conditions are now only in their draft form—should be welcomed by all engaged in the purchase of electrical machinery and plant.

A report has just been issued by the Liverpool corporation dealing with the first complete year of electric traction on the tramways in that city. One hundred and one million passengers were carried, and the average receipts per car-mile were 10.32d. as compared with 12.24d. under the system of horse traction. The working expenses were 8.87d. per car-mile. The total length of the existing lines is some 114 miles. The power-house has a capacity of some 15,000 horse-power.

London, May 24. A. W.

National Electric Light Association at the World's Fair, St. Louis, 1904.

At the recent annual convention of the National Electric Light Association, held in Cincinnati, Ohio, so keen an interest was manifested in the importance of the association's taking an active part in stimulating a prominent and important display of electrical apparatus and appliances at the international exposition to be held in St. Louis in 1904, that it culminated in the unanimous passage by the convention of the following resolution, which was presented by Mr. James I. Ayer, of Boston:

"*Resolved*, That the annual meeting, to occur in 1904, of the National Electric Light Association be held on the grounds of the Louisiana Purchase Exposition Company, at St. Louis, Mo., and that the association will lend its best endeavor to contribute to the achievement of such an electrical exhibit as the consideration of the exposition management (as indicated by their generous provisions) and the industry demands."

Prominent members of the association expressed themselves as being highly desirous of seeing the industrial applications of electricity established on a large scale at the Louisiana Purchase Exposition, and they voiced their willingness to cooperate in any way to secure this end, for the reason that the exposition will have the effect of opening up a great deal of territory now undeveloped electrically, and both the electrical central station managers and the manufacturers are alive to the fact that a proper exploitation of the wide application of electricity will have much to do with extending the use of electrically operated and controlled apparatus and appliances, as well as the augmenting of, in no small degree, the present use of electricity as applied to illumination. It is quite probable that the association will have an exhibit of its own for the demonstration of all present methods for measuring and selling electric energy, whether for light or power. This exhibit will be educational in character and be intended to make the general public more familiar with the methods employed by electric companies in keeping their accounts and in making their charges.

Action was taken this year to hold the 1904 meeting at St. Louis for the reason that the members are convinced that much better working exhibits will be forthcoming if the electrical manufacturers understand that the central station men are thoroughly interested in having all electrical apparatus exploited on a large scale. Within the membership of this association are included, as active members, the men most prominent in the development of electricity and the associated membership contains all of the large electric manufacturing companies. The National Electric Light Association represents an amount in excess of $500,000,000 invested in electrical undertakings.

Uranium and Vanadium.

During the last few years there has been some demand for these metals for experimental work as to their beneficial effect upon steel. Uranium is found in the forms uraninite, gummite and carnotite. The principal occurrences of uraninite are at the Wood, the Black Hawk and the Kirk mines, near Central City, Gilpin County, and on Dolores River at the mouth of Disappointment Creek, Montezuma County, Col. It has also been found on the eastern slopes of Paradox Valley, Montrose County, Col. It has been found in doubtful quantity in the Ross Hannibal mine in the Ruby basin of the Black Hills, South Dakota; in the President mine, near Elizabethtown, Colfax County, N. Mex., and, with gummite also, in some of the pegmatitic dikes of Mitchell County, N. C.

Carnatite, which contains the oxides of both uranium and vanadium, occurs at La Salle Creek, six miles from Cashin, Montrose County, Col., and it is reported from the western slopes of the La Salle mountains in southeastern Utah.

The other principal source of vanadium is canadinite, which has been found in some quantity at the Vulture and the Phœnix mines in Maricopa County, and at the Mammoth mine, near Oracle, Pinal County, Ariz.; and at Lake Valley, Sierra County, and at the Mimbres mines, near Georgetown, Grant County, N. Mex. Vanadium has been obtained from certain slags at Creusot, France, and it has also been found in the ash of certain coals—a source that is attracting the interest of manufacturers and chemists.

Both uranium and vanadium, as ferroalloys, increase to a remarkable degree the tensile strength and toughness of steel, though no commercial steel seems thus far to have been made with them. Uranium compounds are used in manufacturing and decorating porcelain and glass, and canadium is used for vanadium bronze in the place of gold bronze. The production of uranium and vanadium minerals during 1901, confined for the most part to Colorado, amounted to about 375 short tons of the crude ore. The highest recorded price for the crude ore was $150 per ton; uranium oxide has been sold as high as $1.20 per pound.

Reviews of Current Engineering and Scientific Literature.

Giving Concisely the Substance of Important Papers in the Scientific, Electrical and Engineering Press of the World.

Effect of Inductance upon Spark Discharges.

In studying the heating effects upon the poles of a spark-gap, as affected by the variance of the inductance of the circuit, Mr. B. Eginitis uses Tesla coils without a core, and poles of fine wire. The brightness of the aureole varies at first inversely as the heating effect for all metals examined. At high inductance, both the temperature and brightness increase with increasing inductance—at least, in iron and steel. A closer study of the effects by determining the temperatures of the poles was made with the aid of a thermoelectric couple. The metals examined include aluminum, copper and silver. The heating first increases rapidly with increasing inductances, and then breaks into a succession of maxima and minima. The presence of metallic vapor is not a primary factor in the heating effect, as is shown by the fact that at small inductances the brightness of the spectrum decreases with increasing inductances, whereas the heating increases very rapidly.—*Comptes Rendus* (Paris), May 5.

Ions in the Atmosphere.

In demonstrating the ionic charges of the atmosphere, H. Ebert describes some simple and instructive experiments. A plate of tinned iron two square metres in area is supported four metres above the earth's surface on insulating pillars planted on the top of a slope seventy metres high overlooking the River Isar. In clear weather the plate was first connected to earth acquiring a negative charge, then being disconnected and left to itself for some time so as to acquire the potential of the surrounding air. It was then earthed through a galvanometer, and showed a current proceeding from the plate to the earth. The charges acquired vary within wide limits by the weather, being largest in fine and smallest in foggy or damp weather. This shows that the connection of negative ions from the atmosphere to the earth varies in accordance with their mobility in the atmosphere. A rough estimate of the quantity of electricity thus conveyed on a fine day gives about 300,000 electrostatic units per square kilometre per minute.—*Physikalische Zeitschrift* (Berlin), May 1.

Metallization of Textiles.

A method of metallizing textiles electrically, which is said to afford the possibility of impregnating the thickest piece of cloth, either thoroughly or only on its surface, with any kind of metal, has been invented by Dr. K. Donalowski, of Russia. The object is attained by an electrical process of separation of the different salts from a given metal by accumulation of the separated metal in a cathode. There can be used copper, iron, silver, nickel and any of the metals which can be separated from their salts by electrolytic action. The textile has to go through a preparatory treatment before ready for the process of metallization, consisting of impregnating the salt with a solution of the salt of a certain metal. After the cloth has been impregnated, it is submitted to treatment with oxidized sulphur, which causes the metal to be separated from the solution in a sedimentary mass, which, being very fine, intrudes the cloth, uniting closely with its fibres, and also settling down on its surface. When the cloth is thus made ready it is put into an electrolytic tub filled with a solution of the salt of the kind of metal which is to be coated upon it, and brought in contact with the positive surface of an electrical device. The power of the current, as well as the contents of the tub, has to be regulated for each case, respectively.—*Engineering* (London), May 23.

Recent Developments in the Gas Engine.

The latest development in the production of producer gas for gas-engine work is the Mond gas, from which much is confidently expected in the near future. Mond's producer is adapted for the use of cheap fuel and the recovery of ammonia. Experimental work has been carried on for many years (since 1879), and the results now achieved are exceedingly good. Common bituminous slack is fed into the hoppers and then descends in charges of eight to ten hundredweight into the producing bell. The first heating of the slack distills off the hydrocarbons, which then pass down through a hot zone where the tar is broken up. In the body of the producer there is the usual air-blast which has been saturated with steam and superheated, the fundamental difference between this and other heaters being the fact that a very large quantity of steam is used—about two and one-half tons per ton of slack. The large amount of steam used keeps down the temperature and prevents the destruction of the ammonia. Half a ton of this steam is decomposed per ton of slack, giving nearly twenty-nine per cent of free hydrogen in the final producer gas. The gases and undecomposed steam, on their way from the producer, pass first through a tubular regenerator, through which the incoming air-blast passes in an opposite direction, then through a washer where by means of a spray of water they are cooled down to some 194 degrees Fahrenheit, and then to a lead-lined tower filled with tiles, where they meet a down-coming current of acid liquor containing sulphate of ammonia, with a small amount of sulphuric acid. In this tower, therefore, the ammonia of the gas is recovered. Finally, the gases pass to a gas-cooling tower where they meet a current of cold water, and are then fit for use. One producer of the ordinary size can deal with about twenty tons of slack per twenty-four hours, and from 140 to 160 cubic feet of gas are produced per ton. The value of the sulphate of ammonia recovered is about $2 per ton of fuel at present prices. The calorific value of the gas, saturated about fifty-nine degrees Fahrenheit, is about 1,148 British thermal units per cubic foot, and about 1.15 volumes of air are required to burn one volume of the gas.—*Engineering* (London), May 23.

Thermal Expansion at Low Temperatures.

The determination of the densities of substances at the temperature of the boiling point of oxygen and hence of their mean coefficients of expansion between that temperature and ordinary temperatures opens out a very large field of investigation from which, if a sufficient number of observations were available, valuable deductions might be drawn. On account, however, of the expense and trouble of producing quantities of liquid oxygen, its use for this purpose is not likely to become general, although when available it is the easiest body to use in

conducting such experiments, especially when the vacuum vessel containing it is immersed in a large vessel containing the same fluid or well evaporated air. The ease with which liquid air can now be obtained in many laboratories suggests that its application to work of this kind would in some cases be a convenience; and the present investigation was undertaken with a desire to ascertain what accuracy could be obtained, and how the method could be applied to inorganic and organic substances which occur in the form of fine crystals. The use of a mixture of varying composition and density, like liquid air, necessitates a determination of its density with accuracy and rapidity before and during the course of the experiments. For this purpose, in the experiments detailed in this article, liquid air that had been allowed to evaporate for twenty-four hours in advance was used in large silver-coated vacuum vessels of some three litres capacity. In order to ascertain the density of the liquid, a polished silver ball, which had been weighed once for all in liquid oxygen, was weighed in a sample of liquid air, and from the relative weights thus found, the density of the liquid air could be approximately determined, assuming that of liquid oxygen to be 1.137. In this way, with proper care and attention, results were obtained comparable in accuracy with the density taken in liquid oxygen. When the body to be examined was a salt, it was employed in the form of a compressed block. One experiment, however, was made in a section of a large crystal of chrome alum. The salt, previously reduced to a fine powder, was moistened with water and compressed in a cylindrical steel mould under great hydraulic pressure. In order to get cylindrical blocks of the salts, showing no porosity, the presence of water, or, rather, the saturated salt solution, was found to be essential during the application of pressure. In calculating coefficients of expansion, various forms may be given to the formula employed, and correspondingly different results may be obtained from the same set of oxidations. Sodium, extending down to low temperatures, has a coefficient about the same as that of mercury at the ordinary temperature. With the exception of carbonate of soda and chrome alum, all the other hydrated salts have a coefficient of expansion not differing greatly from that of ice at low temperatures. It will be possible, by cooling the moulds with liquid air during the process of hydraulic compression, to produce cylindrical blocks of solid bodies of extremely low melting points. The method which works well with liquid oxygen or air fails when applied to liquid hydrogen. For temperatures about twenty degrees absolute, recourse must be had to measurements of the coefficient of linear expansion, and such observations could only be applied with ease to metallic bodies and alloys.—*Nature* (London), May 22.

Electric Waves and Their Effect on the Human Brain.

This article details some interesting experiments conducted very recently by Mr. A. Frederick Collins for the purpose of establishing the nature of the relationship existing between electric storms and persons afflicted by certain forms of nervous diseases. The brain of a freshly killed animal was procured, and an apparatus for sending out the electric waves of radiations was arranged. It was thought necessary to measure the resistance of the brain, and two needles connected to the testing set were embedded in opposite hemispheres. The high resistance offered by the tissues to the passage of an electric current, especially considering its large cross-section, was surprising. A telephone receiver was introduced in place of the testing set, and two resonator plates connected with two coherer plugs connecting the opposite sides of the brain with the resonator plates, and a dry battery and telephone receiver were bridged in between the two resonator plates. Waves were then sent out by the emitter at a distance of three metres, but there was no sound in the receiver. Had the waves appreciably cohered the brain cells, the telephone would have registered it. It then occurred to the author that the resistance of the brain, like loose metal filings, was too great, and its sensitiveness therefore proportionately decreased. The needles were inserted 1 mm. apart, and the key again pressed. There was a sharp click in the telephone receiver as though a carbon coherer had been employed instead of the brain cells. Time after time the experiment was repeated in all its possible variations, and with many other brains from mammals, but with the same results. The tests proved that cohesion of the brain cells in animals takes place after death under the action of the waves. In order to examine into the action of the living brain, a large feline was subjected to the process of etherization, and was soon in a deep hypnotic sleep. After an incision had been made and the plugs connected up to the opposite sections of the membrane, the needles of the receiving apparatus were inserted into the brain, and the telephone receiver was again selected because of its great sensitiveness. When the sparks passed between the oscillator balls, the sounds of cohesion in the living brain were quite clear, though not as distinct as in the previous tests with the inert brains. The subject was subconscious of the effect, and more ether was applied. The clicking continued, showing that the brain cells were self-righting or "self-restoring," as it is called in the technique of wireless telegraphy. It was accidentally discovered that there were peculiar vibrations felt at the base of the brain and a rhythmic vibration of the muscles. When the emitter was stopped, the vibrations ceased; when in operation, the vibrations were in evidence. The effect was similar to that produced with the so-called "shocking coil," only in this case the current was not broken by any mechanical means. These tests proved that cohesion of the brain cells of mammals in life takes place under the action of electric waves. The resistance of the cross-sections of the brain was measured and found to be about 5,000 ohms which, considering its dimensions, was high. In another test during a storm, a telephone receiver was used, and upon the lightning striking the cupola of a house a quarter of a mile away, three sounds, like the cooling of metal when immersed in water, led the author to believe the lightning had struck three times, which was afterward proved to be true. This was in conjunction with studying the effects of electric waves on the inert human brain, and seemed to the author to prove that cohesion of the brain cells in man after death takes place under the action of electric waves.—*Electrical Review* (London), May 23.

Supreme Court Orders Retrial of Telephone Case.

The United States Supreme Court on Monday ordered a retrial in the famous telephone case of J. Forrest Manning & Company against the Chesapeake & Potomac Telephone Company at Washington, and remanded the case to the District Supreme Court at that city for a new trial.

It will be remembered that Congress had passed a law making the rate $50 per annum for use of a telephone on an individual wire, and this suit is brought by a subscriber to enforce this rate which the company declines to allow.

The District Supreme Court decided that the statutory rates for telephonic service were so unreasonably low that they amounted to confiscation of property, and, therefore, that the act of Congress fixing them was unconstitutional. The Court of Appeals reversed this decision, holding the act to be constitutional and declaring that the telephone company must either abide by it or cease to do business in the District.

The United States Supreme Court now rules that until it was determined which of two classes of service the rates named in the act of Congress applied to, it could not be decided whether the rates amounted to confiscation, and that until this decision was reached the question of the constitutionality of the act should not have been passed upon.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Direct-Current Factory Motors and Small Generators.

The accompanying illustrations show a few applications of small motors and generators manufactured by the Rochester Electric Motor Company, Rochester, N. Y. Although the maker claims reliability and efficiency to be the first considerations in this apparatus, considerable care has been given that they retain a pleasing outline along with compactness and the availability of being readily modified to meet special requirements. The frame has a single casting, the end-plates or bearing supports being bolted directly to it. These plates protect the armature and field windings from mechanical injury, and may be swung around so that the machine may be placed either on the floor, wall or ceiling.

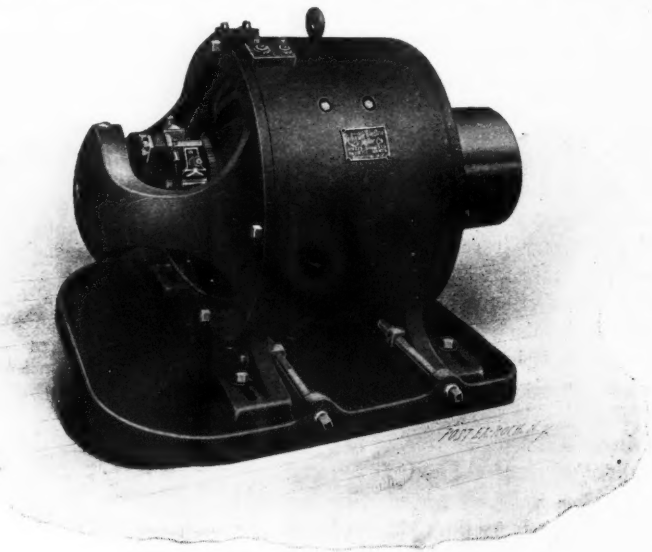


FIG. 1.—MOTOR, WITH SUBBASE.

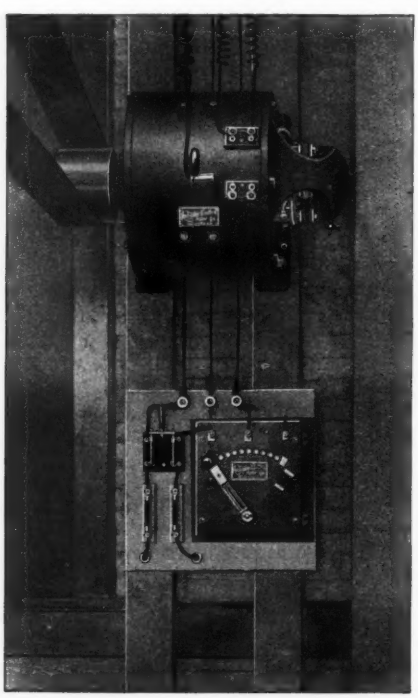


FIG. 2.—WALL-SUSPENDED SEVEN AND ONE-HALF HORSE-POWER MOTOR.

The poles of the multipolar machines are of laminated soft steel and are so bolted into the frame as to make accurate spacing easily secured. This further permits the removal of the poles and field coils without disturbing the armature, the pole tips being shaped to produce a uniformly distributed field, and it is found that these motors will operate without sparking under widely varying loads.

The field coils are machine-wound and carefully insulated with fibre, mica and tape, and slipped over the poles before they are bolted to the frame. The shunt and series coils of compound-wound machines are separate. The armature is built up of thin, carefully annealed sheet steel, the discs being japanned and mounted directly on the shaft, and in all but the smaller sizes there are provided both radial and longitudinal ventilating discs. The windings in all but the bipolar machines are form-wound, taped and baked. There is no bending of the wires when placing the coils in the insulated slots. Bipolar armatures are wound by hand, the wires being laid in the insulated slots and separated from each other by tape, when they are heated and dipped into insulating varnish, then baked slowly in an oven, and finally given a coat of oil and water-proof varnish.

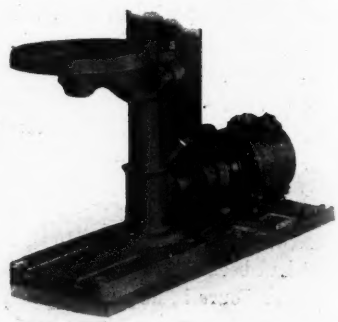


FIG. 3.—MOTOR, BELT-CONNECTED WITH DRILL.

The commutator is given special attention, the bars being of the purest lake copper, insulated with prepared mica. These are held in a special clamp, obviating the possibility of a high or a low bar. The reaction type of brush-holder is used, which provides an absolutely parallel feed with the feed of the brush. The brushes are of carbon, with large surfaces provided for collecting full-load current continuously.

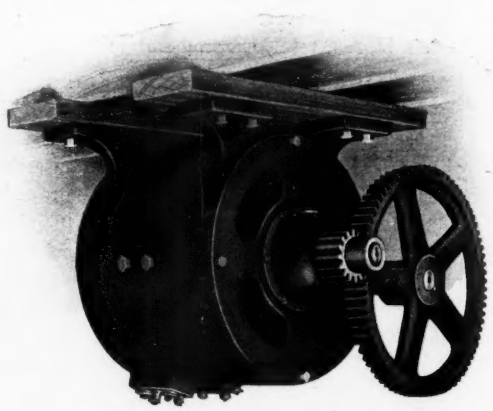


FIG. 4.—CEILING SUSPENDED, BACK GEARED MOTOR.

The bearings are of phosphor-bronze, self-oiling and self-aligning. The oiling rings are of large diameter and feed the

oil to spiral grooves in the boxes, the shaft practically resting on a film of oil when running. The shafts are of high-grade open-hearth steel of large diameter.

Referring to the illustrations, Fig. 1 shows a Rochester motor with subbase;

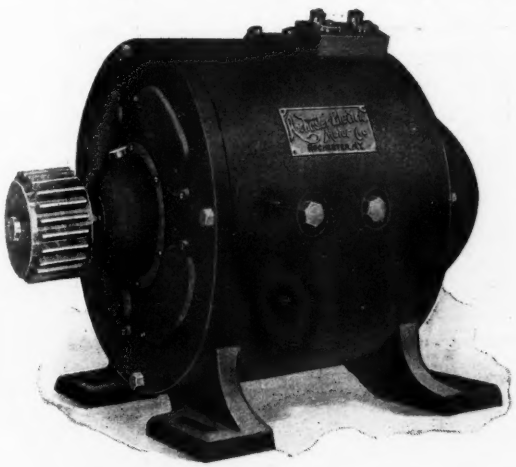


FIG. 5.—ENCLOSED, DUST-PROOF MOTOR.

Fig. 2 shows a seven and one-half horse-power motor, wall-suspended, driving a belt, and also shows the accompanying rheostat and switch apparatus; Fig. 3 shows a motor belt-connected with a Davis drill; Fig. 4 shows a back-geared motor suspended from the ceiling; Fig. 5 shows a Rochester motor entirely enclosed, making it dust and moisture-proof; Fig. 6

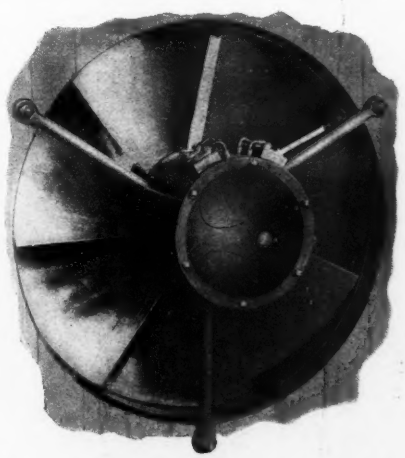


FIG. 6.—MOTOR, DIRECTED TO EXHAUST FAN.

shows a Rochester motor direct-connected to an exhaust fan.

The back-geared type of motor is becoming very popular where slow speed is desired and it is necessary to connect direct. These motors are furnished, when it is desirable, with brass or steel pinions to mesh with cast-iron gear on the shaft. These may also be supplied with special worm-gear reduction for places where extremely low speeds are desired. This machine is adapted for direct-connection to machine tools, printing-presses, blowers, etc.

With the enclosed type of motor the heating effect is very low over long runs. The hand-plates may be removed at any time and the motor operated as an open machine.

A special motor for pumping pipe organs has been designed, this motor running from 300 to 400 revolutions per minute at full speed, being rated at one and one-half horse-power. It is claimed that this motor is very quiet in running, the magnetic hum so often noticeable, and in some cases objectionable, having been overcome.

An Independent Telephone System for Los Angeles, Cal.

The Kellogg Switchboard and Supply Company has secured the contract for the switchboard and 6,000 telephones from the Home Telephone Company, Los Angeles, Cal.

This switchboard deserves particular attention, not only as being the largest single multiple switchboard in the West, but one of the largest that has ever been built, it having a capacity of 18,000 lines. The switchboard consists of seventeen 10-panel, three-operator sections. The first position will be left blank and the remaining fifty positions will be equipped with 120 subscribers' lines each with room for 140, terminating in jacks and lamps, making a present equipment of 6,000 subscribers' lines. In order to meet the requirements of this exchange the multiple jacks will be on three-tenths-inch centres. This will be the first jack of this size, with the exception of the one used in the switchboard of the Frontier Telephone Company, Buffalo, ever used in the world, which likewise is to be equipped with Kellogg three-tenths-inch multiple jacks.

Included in this contract are a two-position chief operator's desk, two-position wire chief's desk, two-position information desk, and a one-position monitor's desk provided with the necessary connections in and to the local board, completely wired for the present equipment. The system is, of course, to be the very latest common battery multiple relay system.

United States Coaling Station at Manila.

One of the most potent factors in the government policy of holding the Philippine Islands was the advantageous position of Manila Harbor as a coaling station for war vessels in the eastern waters. The naval engineers decided that Sangley Point would be the best location for large coal pockets and coal-handling machinery.

Extensive wharves and fireproof buildings are being erected for this purpose. Two coal sheds are each 194 feet wide and 300 feet long with an interval of 50 feet between them, while the wharf is 418 feet in length and 75 feet wide.

The coal-handling machinery was designed to remove coal from colliers by means of hoisting towers and distribute it in the storage sheds by automatic railways; also to coal the war vessels at the wharf from the shed. To do this to the best advantage required two steeple towers equipped with steam hoisting engines and duplex steam shovels, twelve automatic railways and over a mile of track. All this coal-handling machinery, together with accessories, such as railway equipment, cars, coal tubs, etc., is being built by the C. W. Hunt Company, New York.

Recently thirty-six flat-top four-wheel cars were completed and shipped to the Philippine Islands. Each car is of one-ton capacity, to be used on the Hunt industrial railway. Standard gauge for this railway is twenty-one and one-half inches, out to out of rail heads, and is admirably adapted for transporting material on wharves, warehouses, docks and shops.

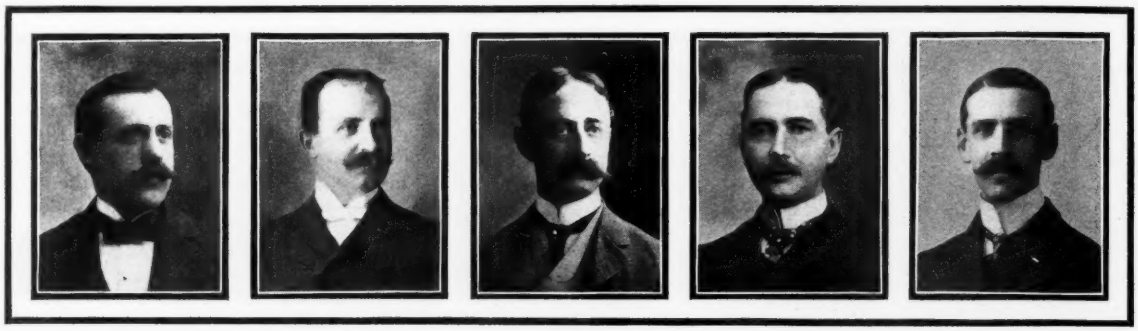
Bauxite.

The bulk of domestic bauxite produced in 1901 was found in Georgia, the remainder being supplied by Alabama and Arkansas. The total production was 18,905 long tons, valued at $79,914, as compared with 23,184 tons, valued at $89,676, produced in 1900. Bauxite is used mostly for the manufacture of aluminum, although a considerable quantity is used for the manufacture of aluminum sulphate and crystallized alum. The Pittsburg Reduction Company is installing a large plant at Bauxite, Saline County, Ark., which promises to largely increase the output from Arkansas in 1903.

The imports of bauxite into the United States in 1901 amounted to $67,117. The exports were valued at $300,000. The consumption was about 39,650 long tons, valued at $151,262. The imports in 1901 were 18,313 long tons, as compared with 8,656 tons for the preceding year. The principal commercial salts of aluminum are aluminum sulphate and crystallized alum, for the manufacture of which bauxite and Greenland cryolite are used. In 1901 the production of aluminum sulphate was 74,721 tons, and that of crystallized alum was 7,755 tons.

The Reorganization of a Large Wire and Cable Company.

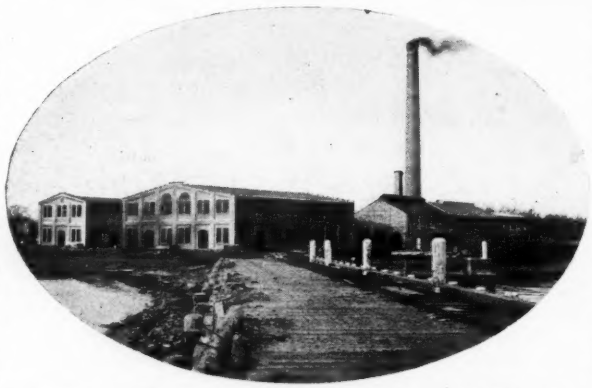
The Safety Insulated Wire and Cable Company, of New York, a name that has always been associated with the pioneer firms of the electrical industry, as the successful manufacturer of the "Safety" seamless rubber insulated electrical conductors, has recently passed through an interesting business experience, which is a fitting climax to its unique and useful career.



EDWIN EPSTEIN, Treasurer. H. T. RICHARDS, Secretary. B. M. WHITLOCK, President. IRA W. HENRY, Vice-President. L. R. CLARK, JR., Vice-President.

The Safety company, formerly a corporation under the New York State laws, with a capital of $250,000, is now a corporation under the laws of the state of New Jersey, where the factory is located, with an authorized capital of $1,500,000, of which $1,000,000 has been issued. The officers of the new company are Benjamin M. Whitlock, president; Le Roy Clark, Jr., and Ira W. Henry, vice-presidents; H. T. Richards, secretary; Edwin Epstein, treasurer; A. P. Eckert, assistant treasurer; A. P. Lambrecht, assistant secretary.

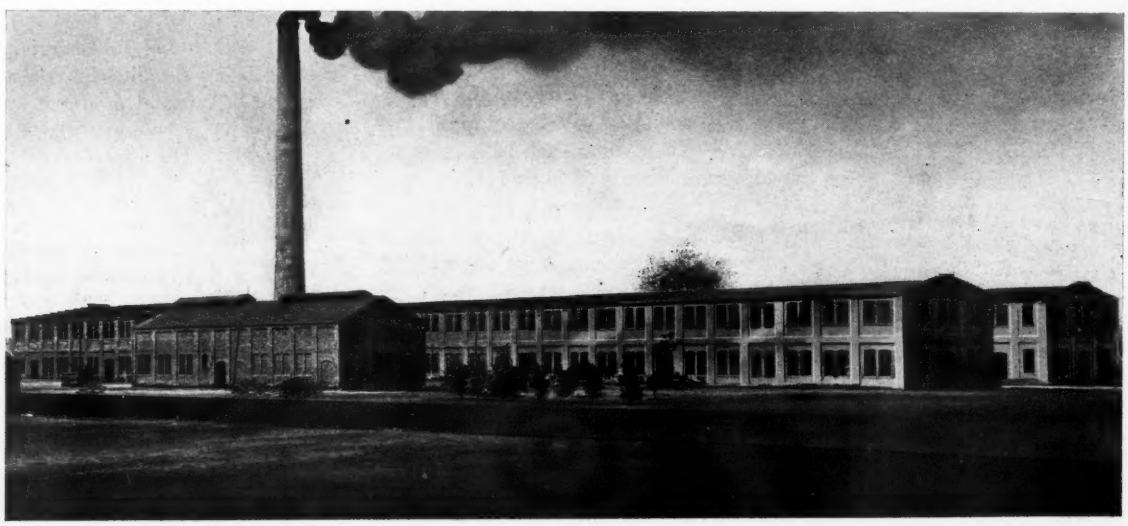
General Whitlock, the president of the new company, was also the president of the old Safety company, is a member of the Union and Players clubs, and the New York, Larchmont and Atlantic yacht clubs, has a large acquaintance in social and financial circles, and is familiar with every branch of the manufacture of insulated wire and cable. Messrs. Clark, Henry, Richards and Eckert have been connected with the successful work of the old company, and Mr. Epstein represents the bankers. Mr. Leonard F. Requa, who was the principal owner of the old company, holds a large interest in the new company, and has been retained as one of its directors in an advisory capacity.



DOCKS AND WATER FRONT AT "SAFETY" COMPANY'S WORKS.

In the accompanying illustrations is shown the new tide-water plant of the company at Bayonne, N. J. This new factory is the largest plant devoted solely to the manufacture of rubber insulated wire and cable in the country. The two main buildings are of brick, two stories high, each having a length of 500 feet, with an aggregate floor space of 150,000 square feet. The power plant, dry rooms, etc., are in separate buildings. Several of the departments of the new factory are already in operation, and the company is completing, at the Bayonne works, a large contract for submarine cable for a foreign government.

Its location at tide-water, with ample docking facilities, new cabling machinery recently imported from England, and a large working capital render the company capable of producing all the usual types of insulated conductors as well as submarine cable of any required length for domestic and foreign markets. The personnel of the new company remains the same, and it starts its career with all the experience and knowledge of the old company whose achievements and contracts in important installations are so well known. The company will be represented as formerly, in Boston, by F. B. Parsons; Chicago, M. B. Austin & Company; St. Louis, Colonel E. J. Spencer; Detroit, Henry L. Walker Company.



FACTORY OF THE SAFETY INSULATED WIRE AND CABLE COMPANY, BAYONNE, N. J.

CURRENT ELECTRICAL NEWS

COMMERCIAL NEWS

DOMESTIC AND EXPORT

TRACTION LINES LOSE TAX SUIT—Back taxes of $397,133 have been released for payment to the city and other taxing bodies through Judge Tuley's decision in the Union Traction Company's case. The judge has dismissed the suit for an injunction for a collection of the tax for 1901, and has ordered the distribution by the county treasurer of the money that was deposited with him by the traction company pending the outcome of its suits. The city will receive about $100,000. It has been stated that the traction company will carry the case to the Supreme Court.

A LARGE CHICAGO ELECTRIC PLANT—It has been reported that Chicago is to have one of the largest electric plants in the world. This is to be built by the Commonwealth Electric Company, and is expected to cost $6,000,000, and have a capacity of 100,000 horse-power. It is believed that its construction will cover a period of five or six years, involving annually an expenditure of $1,000,000. The plant will be erected on fourteen acres of land, fronting south on the south branch of the Chicago River. Work will begin at once, and it has been announced that machinery sufficient for generating 16,000 horse-power has already been contracted for. It is understood that the Commonwealth company will build its plant so that the current may be used for railroad operation, electric lighting and power purposes. It is stated that this company intends to make some radical departures in the character of the machinery to be installed. Title to the land, comprising four parcels altogether, on which the company will build, has been taken for an aggregate consideration of $337,000. The deal has been in progress for several months.

A BIG RAILWAY COMBINE—The Pennsylvania & Mahoning Valley Railway Company has been incorporated under the laws of Pennsylvania, with a capital stock of $8,000,000. The company represents a consolidation of the Trumbull Electric Company, the Mineral Ridge Railway Company, the Mahoning Valley Railway Company, the Newcastle & Lowell Railroad Company, the Newcastle Traction Company, the Lawrence Gas Company, and the Newcastle Electric Company. The combine has also purchased Cascade Park, near Newcastle. It controls ninety miles of track, reaching from Leavittsburg, Ohio, to Newcastle, Pa. The following officers have been chosen: President, M. A. Verner, Pittsburg; vice-president, James Parmelee, New York; secretary, John E. McVey, Youngstown; general manager, A. A. Anderson, Youngstown. The Pennsylvania & Mahoning Valley Railway Company was organized by Colonel Myron T. Herrick, James Parmelee, and Benjamin F. Miles, of Cleveland, Ohio, who owns a controlling interest in the combined properties. The capital stock of $8,000,000 is divided into $3,000,000 five per cent preferred and $5,000,000 common stock. Ultimately it is expected that the road will be a part of a system that will have a through traffic arrangement between Cleveland and Pittsburg. The Eastern Ohio Traction line is now built within a few miles of Leavittsburg, the western terminus of the Pennsylvania & Mahoning Valley Company's road, and is being pushed rapidly forward. From the eastern terminal at Newcastle, Pittsburg capitalists are building an electric line that will shortly be completed, and with which it is expected through service will be arranged into Pittsburg.

IMPORTANT TRACTION DEAL—The Interborough Rapid Transit Company is reported to have acquired the Queens County Railroad, all that company's traction rights, and also the tunnel franchise of the Interisland Construction Company to build a tunnel from a point in Long Island, under the East River, to Forty-second street. The officials of the Interborough company were disinclined to discuss the report, those seen refusing either to deny or affirm it. The Interborough Rapid Transit Company is the corporation organized for the purpose of taking over the subways in Manhattan and the Bronx, being built under the contract between the city and John B. McDonald. The company is capitalized at $25,000,000. The New York & Queens County Railroad Company, which the Interborough Rapid Transit Company is said to have absorbed, controls routes aggregating 110 miles of road. It practically controls all of the trolley lines having their termini in Long Island City on the north side of the island. The capital stock of the company is $2,500,000 and its bonded indebtedness is about $3,000,000. The tunnel franchise possessed by the Interisland Construction Company was obtained a number of years ago. Ten years ago work was begun on the tunnel by the sinking of a shaft forty feet square, between Vernon and Jackson streets, at Fourth avenue. When a depth of nearly 100 feet had been reached about seventy pounds of dynamite, which had been stored near the shaft, exploded, killing five persons, and injuring over fifty. Many suits for damages were started, and the work on the tunnel was suspended. It has never been resumed. If the reported deal has been consummated, 110 miles of trolley lines in Queens County will be brought into direct connection with the entire subway system of Manhattan and the Bronx.

PENNSYLVANIA POWER PLANT—Work has been started on the foundations for the new power plant of the Philadelphia Company which will be erected on Brunots Island at a cost of between $1,800,000 and $2,000,000. It is said that all of the contracts for machinery have been awarded and that final plans are being prepared for the great steel building. The Panhandle Railroad Company has awarded the contract for the new coal chute and trestle on the Ohio Connecting Railroad bridge and work will be hurried along this spring. The new power plant will be just twice the size of the present plant of the Consolidated Traction Company at Twentieth street. The power building will be 500 feet long and 150 feet wide and it will be so arranged that a duplicate building and installation can be secured at any time without destroying the economical operation. The plans have been prepared under the direction of general superintendent John Murphy and chief engineer F. H. Uhlenhaut. The power plant will consist of nine direct-connected Westinghouse generators in units of 1,800 kilowatts or 2,000 horse-power. The contract for these has already been awarded in connection with a monster switchboard and all necessary electrical equipment. The engines will be of the Corliss type in units of 2,000 horse-power. The contract for a battery of Babcock & Wilcox boilers of 10,000 horse-power has been awarded. No contract has yet been placed for the structural steel for the building and the delay in receiving this will constitute the only delay in the completion of the plant. Work was started on the excavations for the foundations. The Philadelphia Company will receive coal for its power plant from the Ohio Connecting bridge. A trestle will be built adjoining the present bridge so that coal cars can be hauled out over the stock pile of the power plant.

ELECTRIC RAILWAYS

SANTA ANA, CAL.—From the engineering work that is going on it is understood that the Pacific Electric Railway Company has taken over the franchise of the Santa Ana & Long Beach Railway Company and will build a road to connect the two points.

ELGIN, ILL.—The Elgin, Aurora & Southern Traction Company has commenced the work of strengthening its track system in the downtown streets which will be paved during the coming summer. The paving will commence at once.

CRESTLINE, OHIO—The council has passed the franchise asked by the Ohio Central Traction Company to pass through the Highland addition in that village, thus giving the traction company a route through the village, allowing it to connect up its lines.

INDIANAPOLIS, IND.—The county commissioners have granted a new franchise to the Indianapolis, Shelbyville & Southeastern Traction Company for a right of way through Marion County. The company's former name was the Shelbyville Street Railway, Heat, Light and Power Company, and its franchise expired March 1.

PHOENIXVILLE, PA.—An ordinance has been adopted giving franchises to the Bridgeport & Phœnixville Electric Railway Company, which is the connecting or intermediate link of the trolley system between Norristown and Philadelphia. The company is placed under bonds of $10,000 for the faithful compliance with all requirements of the ordinances. If the road

is not completed within six months from date of acceptance then the ordinance becomes null.

URBANA, ILL.—A new electric railroad to run from Champaign and Urbana to Gibson City, Hoopeston and Atwood and to carry both passengers and freight has been incorporated here. The incorporators are Judge Francis M. Wright, M. A. Goff and State Auditor McCullough, of Urbana, and J. W. Davidson. The capital stock is $35,000 and the road is expected to be in running order early next year.

PITTSBURG, PA.—The Pittsburg & Charlerroi Street Railway Company will by October have a complete traction system in operation between Union station and Allenport, opposite Fayette City, in the Monongahela Valley, which will be about thirty-four miles long and about ten miles shorter than the Pittsburg, Virginia & Charleston Railroad. Links of the new road beyond Mt. Lebanon are being completed by the Drake & Stratton Company, the entire cost being $2,500,000.

PADUCAH, KY.—The articles of incorporation of the Paducah City Railway have been filed, with a capital stock of $300,000. This company has fifteen miles of track and a light and power plant. The organization contemplates betterments and extensions of the line, and provides for a large bond issue to make this possible. The old directors are to continue in their positions, the new management not contemplating any radical changes. Charles S. Maltby, of the Maltby-Hornaday Company, of Cincinnati, is the chief operator.

HARRISBURG, PA.—The State Department at Harrisburg, Pa., has granted a charter to the Jamestown & Warren Electric Street Railway Company, and the articles of incorporation announce the following capitalists of Warren as directors of the recently organized traction corporation: D. H. Siggins, president of the Warren Street Railway Company, together with J. D. Woodward, J. F. Rounce, H. A. Siggins, and J. M. Siegfried, who is named as the treasurer of the company. It is estimated that the construction cost to the New York state line from Warren will be $10,000 per mile, and for that purpose subscriptions for $100,000 in stock have been received. Nineteen miles of track will be built in all.

LANCASTER, PA.—Through an agreement reached between the officials of the Conestoga Traction Company, which controls all the trolley lines in this county, and the United Traction Company, of Reading, this city will be connected with Reading by a continuous trolley system. It has been stated that the line to Ephrata would be extended to Adamstown, a distance of nine miles. The United Traction Company has a line from Reading to Adamstown, where the junction with the local system will be made. A subpower station and electric light plant will be established at Reamstown, through which the new line will pass, for the purpose, it is understood, of furnishing light to Reamstown, Denver, Terre Hill, Adamstown and New Holland.

NEW INCORPORATIONS

HARRISBURG, PA.—The Roscoe Electric Light Company. $10,000.

CHICAGO, ILL.—Illinois Western Telephone Company, Macomb. Capital increased from $60,000 to $300,000.

DOVER, DEL.—The Louisville Home Telephone Company. Increased capital stock from $1,000,000 to $1,500,000.

ANDERSON, IND.—The Emporia & Anderson Telephone Company. Increased capital stock from $5,000 to $20,000.

SPRINGFIELD, ILL.—Pleasant Ridge Telephone Company. $1,000. Incorporators: I. S. Caster, W. H. Clark and S. L. Veily.

CHICAGO, ILL.—Gilman Electric Light and Power Company. $25,000. Incorporators: Robert W. Parker, Emil C. Wetten and Clyde A. Morrison.

ALBANY, N. Y.—Smith Storage Battery Company, Binghamton. $100,000. Directors: T. J. Coster, M. O. Smith and A. C. Rahe, Binghamton.

MADISON, WIS.—Sparta-Melrose Traction Light and Power Company. $25,000. Incorporators: D. W. Cheney, W. T. Sarles, T. O. Thorlas and others.

ST. PAUL, MINN.—Union Manufacturing Company. $10,000,000. Incorporators: F. B. Bruce, L. S. Hackney, F. S. George, F. D. Kendrick and C. H. Shellenberger.

SAN FRANCISCO, CAL.—Stanislaus Water and Power Company. $2,500,000. Incorporators: W. F. Pierce, W. Gregg, Jr., J. E. Green, H. P. Veeder and H. G. Veeder.

BALTIMORE, MD.—The Kingsbury-Samuel Electric Company. $5,000. Francis G. Boyd, Robert A. Regester, Myer Rosenbush, Gebhard Leimbach and William Hofmeister.

COLUMBUS, OHIO—The Barberton Belt Line Railroad, the Cleveland, Barberton & Western Railroad, and the Barberton, Alsson & Eastern Belt Line Railway, consolidated, $900,000.

SANTA FE, MEX.—New Mexico Light and Power Company. $500,000. Chester D. Coram, of Boston; M. W. Huorway, C. K. Newhall, Edward L. Medler and E. J. Alger, of Albuquerque.

ALTOONA, PA.—The Citizens' Electric Light Company. $150,000. Directors: S. S. Reighard, Ferdinand Bendheim, Earl Olmes, Charles Moore, I. C. Neishler, W. W. Murray, C. E. Wolfe and T. M. Biddle.

MADISON, WIS.—Marion Northern Telephone Company. $25,000. Incorporators: W. R. Binkelman, Frank Leake, N. W. Engler, C. H. Zellmer, L. M. Goldberg, Charles Engel and J. D. Laughlin.

GUTHRIE, OKLA.—The Lawton & Caterville Electric Railway Company; $500,000; incorporators: T. W. Brewer, C. L. Smith, J. E. Williams, A. L. Quint, I. K. Lewis and J. W. Martin, all of Lawton. The Blackburn Improvement Company; $10,000; incorporators: M. W. Rhodes, C. H. Schultz, John K. Landis, W. E. Brady and Frank Landis.

TELEPHONE AND TELEGRAPH

EAST AURORA, N. Y.—The village board has granted the Haines Telephone Company, of Buffalo, a franchise to construct and operate a line. Work is to begin at once.

WEEPING WATER, NEB.—The Plattsmouth Independent Telephone Company has just installed a system with a local exchange, and it is now open for business. It is operating about 100 telephones and has sixty contracts for farm lines. C. E. McClain will be the local manager for the company.

ALBANY, N. Y.—The International Bell Telephone Company, Limited, of New York city, of which Charles J. Bell, S. D. Babcock, Charlton T. Lewis, Fred M. Thieriot and D. H. S. Randall are directors, has certified to the Secretary of State that its capital has been reduced from $500,000 to $250,000.

HOOSICK FALLS, N. Y.—The Eastern New York Telephone and Telegraph Company, which recently was granted a franchise by the board of village trustees, will apply to the highway commissioners of the town for requisite permission to set poles and string wires outside the limits of the village corporation.

CLEVELAND, OHIO — The Everett-Moore Syndicate has disposed of its interest in the company at Galion for $36,000, which represents nearly the entire amount involved in the construction of the system. The total cost was $50,000. Solomon M. Wolf, of Bellevue, is the purchaser. The Galion exchange has 700 connections.

MILWAUKEE, WIS.—Articles of incorporation have been filed by the Independent company, of Milwaukee, with a capital of $50,000, with Edwin Reynolds, E. A. Wadhams and F. C. Winkler as incorporators. The company will ask a franchise of the common council and if it is granted will start a telephone system to the Wisconsin company.

DECKERTOWN, N. J.—The Warwick Valley Telephone Company will extend its lines to Vernon, Glenwood, Edenville, Amity, Florida and Pine Island. A meeting of representative residents of these localities has been held in that village and committees were appointed which secured subscriptions for stock amounting to $2,020 and orders for forty telephones.

NEW ORLEANS, LA.—The Southwest is to have a new telephone system. The lines and plants are already installed through a large part of Texas, and the first step in Louisiana was made when work began in Shreveport recently. The plant is now being constructed in Shreveport and the wires strung, and it is expected that the system will be in working order in about six months.

TERRE HAUTE, IND.—The entire system of the Central Union Telephone Company is being overhauled, and the service will be greatly improved. A new section is being placed in the switchboard which will ac-

commodate fifty new telephones, and extra operators have been employed. During the past sixty days about fifty new telephones have been placed in residences and places of business throughout the city.

MOLINE, ILL.—The Union Electric Telephone Company has purchased a site for the erection of its own building in Davenport, and this will probably also be done in this city and Rock Island. The company expects to start a force in the three cities soon and to push the work with a view to completing the systems in the fall. The surveys and plans which will form the basis of the plant in this city are practically completed.

ST. LOUIS, MO.—The People's Telephone Company, of Montgomery County, has completed the extension of its lines into Warrenton and made connections with the Bell service, thereby giving the people of the county long-distance connections with St. Louis. It includes the following towns: Warrenton, Danville, Mineola, Americus, Pendleton, Gerdemann's store, Jonesburg, High Hill, New Florence, Montgomery City and other points.

OSKALOOSA, KAN.—The Oskaloosa Independent Telephone Company has dissolved, and A. B. Clark, one of the former proprietors, now owns the entire system. There are 150 telephones in this system, and a stone building is being erected for a new central. C. B. Harman and J. A. Zimmerman, of the Valley Falls Independent Telephone Company, have sold their Baldwin telephone lines from valley Falls to connect with Topeka, Atchison and Leavenworth.

BAY CITY, MICH.—The Michigan Telephone Company has begun the construction of five new lines between Bay City and Saginaw. When they are completed the company will have ten circuits to the upriver town and it is expected that this will fulfill all requirements for years to come. Local construction work is going on steadily. The company has not yet completed the laying of all its cables, but has removed poles from nearly twenty blocks during the past six months.

BLUFFTON, IND.—The United Telephone Company of this city has sold the Home Telephone Company, of Portland, the independent telephone system in the latter city. The system there has 317 patrons. The United Telephone Company of this city still owns thriving telephone systems in a number of Indiana cities, including among its properties the plants at Huntington, Marion, Upland, Hartford City, Montpelier and Bluffton, in addition to several hundred miles of connecting toll lines.

COOKSVILLE, ILL.—Application has been made for the incorporation of the Cooksville Telephone Company. It will take over the lines of the existing rural service out of Cooksville and have connection with the McLean County system and lines to all surrounding towns. There are already two rural lines under construction and applications for several more, and the purpose of the incorporation is to adequately handle this business. The capital stock is $8,000 in 200 shares of $40 each. The incorporators are Dr. P. L. Noggle, E. J. Carmody, Calvin Winkelpleck, Samuel Hutchinson and Joseph Arnold.

ELECTRICAL SECURITIES

With the single exception of the coal strike situation, all news affecting the stock market last week would seem to justify higher prices. If the conditions of the coal strike and the holiday at the end of the week could have been set aside, there would in all probability have been much higher prices. As it was, the condition in Wall street for the four days of trading was one of apathy, there being little, if any, developments of any significance.

The welcome and long-waited news of the favorable conclusion of negotiations in South Africa will no doubt be followed by an upward tendency in the London market, which will be participated in to a more or less intense degree in Continental financial circles, and there is every reason to believe that considerable of this bullish tendency will cause a flow of good trading to the United States markets. Some hopes are entertained in regard to favorable developments in the coal strike. Although there is nothing but rumors to form the basis of opinion, Wall street generally looks for important developments in the strike during the coming week, and great confidence is also expressed that these occurrences will be of a favorable nature.

Money holds very easy, with the bulk of call loans at three per cent. A similar condition, it is believed, will hold for the entire summer, and this will be a help to the stock market's stability.

ELECTRICAL SECURITIES FOR WEEK ENDING MAY 29.

New York:	Closing.
Brooklyn R. T.	67
Con. Gas	226
Gen. Elec	327
Kings Co. Elec	200
Man. El	132
Met. St. Ry	148
N. Y. & N. J. Tel. Co	175
Westinghouse Mfg. Co	219

The temporary injunction which for over six years has been standing against the Brooklyn Heights Railroad, restraining it from laying tracks through Liberty street at the Brooklyn end of the Bridge, has been vacated by Supreme Court Justice Smith. The vacating of this injunction will make it possible to lay tracks through the Bridge Plaza, which it is expected will greatly facilitate the operation of cars and will relieve the crush during the busy hours.

Boston:	Closing
Am. Telep. & Tel	179½
Edison Elec	276
Mass. Elec. pf	97
New England Tel	147
Western Telephone & Telegraph	101

Massachusetts Electric was the feature of the week, holding firm under considerable trading, and making slight advances to 45.

Philadelphia:	Closing.
Elec. Co. of America	7⅛
Elec. Stor. Bat. c	89¼
Elec. Stor. Bat. pf	89
Philadelphia Elec	5¼
Union Traction	42⅛
United G. I. Co	104

Union Traction gross receipts for the first twenty-two days of May increased $43,000. This rate of increase, while not so large as that for April, will probably bring the year's results up to the estimate of the management.

Chicago:	Closing
Chicago Edison Light	175
Chicago Telep	170
Metropolitan El. pf	90
National Carbon	25
National Carbon pf	91
Union Traction	18⅞
Union Traction pf	55

ELECTRIC LIGHTING

ITHACA, N. Y.—The Citizens' Light and Power Company, of Auburn, has begun the foundation of its power-house. The work on the system is progressing rapidly.

BRANFORD, CT.—The Branford Light and Water Company contemplates extensive improvements and additions to its plant and will also greatly extend its pole lines and lighting system.

GLENDIVE, MONT.—The Hughes Electric Company, which owns and operates electric light plants at Staples, Minn., Bismarck and Dickinson, N. D., is erecting a building for the plant which it will put in here. The company will furnish electric lighting, electric power, steam heating and telephone service for the city.

JERSEY CITY, N. J.—The Erie Railroad tunnel at Jersey City is being equipped with electric lights and it is expected that the system will be in operation within a short time. There will be 150 lights, placed at intervals of fifty feet. They will be on a level with the locomotives, so that engineers can have no trouble in seeing them.

KINGSTON, N. Y.—A new $700,000 corporation called the Kingston Gas and Electric Company has been formed in this city to manufacture gas and electricity for lighting and heating the streets, parks and public and private buildings in the city and in the towns of Ulster, Esopus, Hurley, Woodstock and Kingston, and to supply gas for fuel to the residents thereof for manufacturing, domestic and other purposes.

ST. LOUIS, MO.—The merging of the Imperial, City, Seckner and Citizens' electric lighting companies into the Union Electric Light and Power Company, with a capital stock of $20,000,000, has been ratified by stockholders' meetings. Julius S. Walsh will, it is expected, be president of the united interests. An issue of $10,000,000 in stock and an equal amount in bonds will be made. Of the bond issue, only $4,000,000 is to be used at the start, the rest being held in the treasury.

EASTON, MD.—The Easton Fuel and Light Company has purchased the plant and franchises of the Easton Gas and Electric Light Company. This is a new company incorporated in Dover, Del., with a capital stock of $50,000. The directors are Harry A. Richardson, of Dover; Fred R. Owens and William A. Deweese, of Denton; Judge William R. Martin, of Easton, and William King, of Philadelphia. An ordinance has been passed by the town commissioners of Easton contracting with the new company for lighting the town.

INDUSTRIAL ITEMS

THE MONOPLEX TELEPHONE, manufactured by Atwater Kent, Philadelphia, Pa., is designed with particular attention to apartment-house, factory, hotel or office service.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, in its June number of the historical series of calendars portrays the career of James Clark Maxwell.

VALLEE BROTHERS ELECTRICAL COMPANY, Philadelphia, Pa., is about to issue new catalogues, one of which will be devoted to telephone apparatus and another to electrical house goods.

THE ROCHESTER ELECTRIC MOTOR COMPANY, Rochester, N. Y., is mailing a neat folder to prospective patrons, entitled "About Profits," which pleads for the economy of operating small direct-connected motors.

PROFITABLE ADVERTISING, published by Kate E. Griswold, of Boston, Mass., in the special June issue takes up the subject of electricity as applied to advertising in a most comprehensive and entertaining manner.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., has been increasing its facilities in its telephone department to such an extent that it is now in shape to keep up with its orders for switchboards, telephones and parts.

THE KELLOGG SWITCHBOARD AND SUPPLY COMPANY, Chicago, Ill., is distributing an interesting postal folder entitled "What's Wanted." This shows in half-tone and diagram a standard subscriber's instrument, a "cut-in" station and a circuit.

THE ELEVATOR SUPPLY AND REPAIR COMPANY, Chicago and New York, is the manufacturer of Bishop's patent dynamos and motor brush-holder, an ingenious device for adjusting the brush contact of electrical machinery designed to reduce sparking to a minimum.

FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., is sending out a neat instruction book on its Type A oil transformers. The company also is placing with its friends a panel calendar for June, and a catalogue of parts of "Wood" dynamos. This may be had on request.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., has produced another magnificent catalogue descriptive of Reynolds-Corliss engines built by this company. The book comprises 180 odd pages, is splendidly printed on heavy coated paper, and is replete with descriptions and half-tone illustrations of the machinery and installations.

JOHNSON & MORTON, Utica, N. Y., have opened a New York office at 232 Greenwich street, where they will be represented by Messrs. Frorup & Levy. A number of improvements have been made in this company's line of all-copper panel boards and switches, and a complete stock of these will be carried at the New York office.

SECTION A OF THE "MECHANICAL INDEX," comprising machine tools, metal working machinery and accessories, machinist's small tools, etc., is published by the Industrial Press. This is a fine book and is a comprehensive index to manufacturers in the United States of mechanical appliances and tools operated by steam, electricity, water, air, hand or foot power.

THE AMERICAN CONDUIT MANUFACTURING COMPANY, New Kensington, Pa., reports a decided growth in the sales of the "American" electric wire conduits. This company also manufactures couplings, elbows, etc., etc., as used in electric wire construction work. These products are enameled both inside and outside and are accepted with approval by many of the leading electrical engineers.

MACHADO & ROLLER, New York city, manufacturers of electrical instruments, have concluded an arrangement with F. B. Sage & Brothers, under which they have taken over the exclusive manufacturing and selling rights for the ohmmeters formerly made by the latter company. These devices will be manufactured by the Whitney Electrical Instrument Company, for which Messrs. Machado & Roller are the general selling agents.

THE BOSTON & MONTANA CONSOLIDATED COPPER AND SILVER MINING COMPANY is making considerable additions to the electrical equipment of its smelters and refineries at Great Falls, Mont., having recently purchased eleven 15-horse-power and three 40-horse-power Westinghouse, 500-volt, shunt-wound, direct-current motors. About four years ago this company installed a number of Westinghouse 180-volt, electrolytic generators and at the same time put in a large number of Westinghouse and other motors for driving ventilating fans and other machinery about the smelters. Although the smelters are filled with sulphur dust and are extremely dirty, the motors have given excellent satisfaction.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., reports a very satisfactory increase in orders received during the month of May over those for the preceding month. Recent experience has demonstrated to the company that the demand for its direct-current dynamos and motors for manufacturers and users of electric power machinery is based upon the satisfaction resulting from previous sales to these various concerns. Consequently, the company is making extensive preparations to accommodate the increasing business which during the past year has pushed the present shops to their utmost. A new building is under construction which will enlarge the present floor space by 60,000 square feet and will be occupied by the winding department, a part of the office force, and additional machine shop space.

THE NATIONAL ELECTRIC IMPROVEMENT COMPANY, New York city, N. Y., has issued a splendid forty-eight-page souvenir booklet descriptive of its system—the "Elblight"—for electric display illuminating, decorative lighting, signs, emblems, etc. There are twenty-one handsome illustrations, with complete descriptive matter, the whole being artistically arranged and admirably printed. The Elblight system, which consists of twin cables carrying two conductors in which are stabbed miniature frosted lamps, is meeting with great favor, and is rapidly growing in popularity for advertising and decorative effects of every description. At the recent electric light convention this company had a brilliant display. Unfortunately, however, there does not appear in this excellent booklet any reproduction of the effects which were secured in the design shown in Cincinnati. It is to be understood, that however excellent the photographs and half-tone reproductions may be, only the faintest conception can be gathered of the beauty of this decoration as it stands in reality.

PERSONAL MENTION

MR. WILLIAM TYSON GOOCH, of the firm of Harding & Gooch, architects, announces the dissolution of this firm and his entrance into the firm of Charles Henry Davis and partners, where he will continue to practice architecture.

MR. H. F. SANVILLE, who has been secretary of the Morris Electric Company for several years, is about to sever his connection with that company for the purpose of establishing an agency in Philadelphia for the representation of several manufacturing companies producing electrical and street railway supplies.

MR. G. A. ANNABLE assumed the New York agency for the Cutter Company, of Philadelphia, and the Keystone Electrical Instrument Company on June 2, with offices at 120 Liberty street, telephone No. 1130 Cortlandt. Mr. Annable has been identified with these interests for many years, and this change is merely a personal assumption of these companies' New York interests.

MR. F. G. BOLLES, manager of the Advance Department of the Bullock Electric Manufacturing Company, of Cincinnati, was the sponsor for the idea of publishing the daily bulletins of the attendance at the recent convention of the National Electric Light Association. These bulletins were printed by the Bullock company's press and were artistic typographically, and accurate in giving the name, locality, whence he came, and hotel in which he was living, of each visitor to the convention.

MR. B. S. BARNARD.

MR. B. S. BARNARD entered the employ of the American Vitrified Conduit Company as a salesman in 1899. At this time the underground conduit business of this country and Europe was somewhat in its infancy. By degrees Mr. Barnard has placed his company among the foremost in the ranks of the conduit business, and as sales manager has now placed it in the position of having its product oversold for several months to come. Many of the greatest engineering propositions in this country have installed the material manufactured by this company. This success is greatly due to the efforts of Mr. Barnard whose popularity and good work are rightly commended. He is well qualified to represent the progressive firm that he does and is well supported by all in the position he occupies.